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NOTES ON THE SEA OTTER

BY OLAUS J. MURIE

Mammalogists have been greatly interested and encouraged by the apparent come-back of the sea otter (*Enhydra lutris*) in recent years, both in Alaska and California. Interesting observations have been published recently by several investigators. As I have had the opportunity to observe the animal in Alaska and California and have been able to make certain comparisons, the following notes are offered as an addition to the published information that has been accumulating.

In the spring of 1936 it was my good fortune to conduct an expedition to the Aleutian Islands to study, with the assistance of C. S. Williams, the fauna and the administrative problems of the Aleutian reservation, now directed by the Biological Survey. Douglas Gray and Homer Jewell of the Alaska Game Commission accompanied the expedition. Mr. Williams has published an account of observations made on the sea otter during this trip, including data on food habits based on his examination of 70 droppings collected that summer (Jour. Mamm., vol. 19, no. 1, pp. 105–107, 1938).

In 1937 I returned to the Aleutians, this time accompanied by Dr. Victor B. Scheffer and John H. Steenis, the Alaska Game Commission again being represented by Mr. Gray. On this trip we collected one sea otter stomach and 196 droppings, which were analyzed on my return to headquarters. Again, in the summer of 1938, Dr. Scheffer made a very brief trip to the Aleutians, obtaining 9 more sea otter droppings, which he kindly sent to me on his return.

With our combined observations and collections of material over a period of 3 years we feel that we now have a good basis for understanding the feeding habits and food preferences of the Alaska sea otter.

In 1938 I spent several days on the California coast in company with my

brother, Adolph Murie, photographing and observing the animals there. This furnished an opportunity for comparisons. While we do not by any means have a complete picture of the life of the sea otter, the following notes are offered as an addition to our knowledge of this interesting animal.

FOOD HABITS IN ALASKA

The sea otter obviously does not share the river otter's fishing habits. Although fish remains did occur 22 times in 198 samples, they often consisted of roe and sometimes of bones of small fish. Some of these fish, if not all,

TABLE 1.—*Food of the Alaska sea otter (198 scats) 1937 expedition*

ITEM	AVERAGE PERCENTAGE BY VOLUME	TIMES OCCURRING	GREATEST PERCENTAGE IN A SINGLE SAMPLE
Sea urchin, *Strongylocentrotus drobachiensis*	74.9	188	100
Mussel, *Mytilus*, *Modiolus* and *Musculus*	8.8	75	100
Chiton, chiefly *Tonicella ruber*, also a few *Schizoplax brandtii*	4.3	72	100
Crab	4.2	65	100
Limpet	3.6	70	100
Snail (several species)	1.1	85	66.2
Fish and fish roe	.99	22	42.1
Rock oyster, *Pododesmus macroschisma*	11	17	17.6
Other bivalves, including *Venericardia paucicostatus*	.21	25	17.9
Pecten, *Pecten beringianus*	trace	12	trace
Octopus	trace	2	.02
Unidentified crustacea	trace	6	.06
Sea otter hair	trace	15	trace
Pebbles	trace	frequent	21.8
Coral	trace	11	4.9
Barnacle	trace	2	trace
Seaweed	trace	5	.5
Bryozoa	trace	5	trace
Black dirt	trace	2	100

may have been carrion. The Aleuts told us that a greenling, *Hexagrammus* sp., which is abundant in the tide waters, deposits its eggs in the kelp; it is possible that the roe found in the scats was obtained there. On one occasion a sea otter was seen feeding on a dead cod, *Gadus* sp., lying on a bed of kelp. At any rate, fish are an unimportant part of the sea otter's diet.

Reference to the accompanying tables and the data previously published by Mr. Williams reveals a uniform food preference, over a period of 3 years and at three different islands. Sea urchin is without question the universal food. In numerous instances it constituted 100 percent of the scat contents

and occurred in at least a small degree in nearly every sample. Spines, tests, and Aristotle's lanterns are ingested with the soft parts.

It seems significant that in primitive times the sea urchin was one of the important items in the diet of the native Aleuts. Sea urchin remains are prominent in the village middens excavated among the Aleutian Islands, though generally mixed with many fish bones. Being curious about this article of food I tried two sea urchins myself, fresh from the sea water, and was surprised to find in them an agreeable flavor, though I avoided the bitter gonads.

Mussels and chitons vie for second place in the diet, mussels perhaps leading, probably because they are the more bulky. Either of these occasionally made up 100 percent of the food and their times of occurrence were nearly equal.

TABLE 2.—*Food of the Alaska sea otter (9 scats) 1938 expedition*
Collected by Dr. Victor B. Scheffer

ITEM	AVERAGE PERCENTAGE BY VOLUME	TIMES OCCURRING	GREATEST PERCENTAGE IN A SINGLE SAMPLE
Sea urchin, *Strongylocentrotus drobachiensis*	90.2	9	100
Mussel	.4	2	3.5
Chiton, *Tonicella ruber*, with trace of *Schizoplax brandtii*	3.1	7	12.9
Crab	.7	6	2.7
Limpet	2.9	7	9.2
Snail	trace	4	trace
Fish	1.6	2	13.6
Pebbles	.9	7	3.5
Bryozoa	trace	1	trace

It is of interest to note here certain local differences in percentage, as shown in the table on page 122.

These figures show that limited numbers of samples from restricted areas are not truly representative. Also that availability may be important. It would appear that mussels, requiring a somewhat specialized habitat, are less generally distributed. Chitons and snails are small, less easily gathered in quantity; but their presence in such numbers indicates their high palatability.

It was surprising to find such large quantities of hard, jagged materials in the droppings. It appears that often mussels are simply broken, then swallowed, for some droppings consist almost entirely of jagged pieces of shell, large and small, as well as byssus and attached rock or coral. Pebbles in one instance made up 21.8 percent of the scat contents. Pieces of crab shell,

rock oyster shell, and limpet shells are all swallowed with the soft parts. Yet there appears to be some effort to discriminate, for it was often noted that

ITEM	AVERAGE PERCENTAGE	TIMES OCCURRING	GREATEST PERCENTAGE IN A SINGLE SAMPLE
Ogliuga Island, 140 samples			
Sea urchin	80.8	137	100
Mussel	.6	32	33.6
Chiton	5	61	88.2
Crab	5	41	100
Limpet	5	60	100
Snail	1.5	63	66.2
Amchitka Island, north side, 32 samples			
Sea urchin	50.7	27	100
Mussel	44.4	30	100
Crab	1.06	13	13.2
Limpet	trace	2	trace
Snail	trace	6	trace
Amchitka Island, south side, 21 samples			
Sea urchin	78.1	19	100
Mussel	5	7	91.2
Chiton	7.3	11	100
Crab	1.3	8	23.1
Limpet	1.3	8	16
Snail	1.1	16	21
West Unalga Island, 5 samples			
Sea urchin	54.2	5	100
Mussel	28.9	4	100
Crab	16.8	3	65

It will be noted that at Ogliuga Island alone sea urchin percentage rose to an average of 80.8 percent, with at least 60 droppings containing 100 percent. And mussels dropped to a low average of 0.6 percent. Limpet rose here to 5 percent average, with 100 percent in one case.

On the north side of Amchitka Island sea urchin dropped to 50.7 percent, with 44.4 percent mussels, while on the south side sea urchin rose again to 78.1 percent and mussels dropped to 5 percent. But mussels were again very prominent at West Unalga Island.

the sea otter held the food morsel in its paws and picked at it with its teeth, frequently throwing away a piece with a quick forward toss of one paw.

FOOD HABITS IN CALIFORNIA

Observations on the California species were very limited and droppings for analysis unfortunately could not be obtained. But some interesting comparisons were made. Here, too, the sea urchin is prominent in the diet, but it is the large purple one with long spines, which entails a different method of handling. In Alaska, to judge by the voluminous remains of hard parts in droppings, the soft food substance is not carefully separated from the tests. But in California the animal appeared to make an opening in the armor of spines and plate, through which it reached the soft parts. Then the empty test was discarded. Just how this was done was not seen in detail, but at intervals there was a flash of light color as part of the "meat" passed into the mouth, until finally the bulky test was dropped.

In California, also, the abalone formed an important food item, probably requiring special technique in gathering and eating. This food is not available to the Alaska animals.

Another amazing habit was first observed clearly in California, that of breaking a shell on a rock fragment, as recently described by Edna M. Fisher (Jour. Mamm., vol. 20, pp. 21–36). We learned that several local people had seen this and presently we saw it repeatedly, and my brother obtained colored motion pictures of the process. The otter would come up from under-water foraging and when it turned over on its back there would be a piece of rock resting on its abdomen or chest. Then with a vigorous sweep of its paws it beat a tattoo on the rock with what appeared to be some medium-sized mollusk which we could not identify. Apparently it employed this means to break a hard shell. The tapping sound was audible at a considerable distance.

I believe this habit is shared by the Alaska sea otter. A number of times in the Aleutian Islands we heard a similar tapping sound, but my interpretation at that time was probably faulty. We were not near enough on those particular occasions to see details and I assumed that the otter was merely breaking a sea urchin on its chest by tapping it with its hard, calloused paw. In the light of later experience in California it seems more probable that the Alaskan animals were also using a rock fragment as a tool. As reported above, great quantities of mussels are consumed. Possibly these are artificially crushed, and possibly, too, mussels were the tidbits we saw thus handled in California. At any rate this unique and surprising habit appears to be common to both groups of sea otters.

In Alaska, traces of seaweed in droppings were thought to be more or less accidental and perhaps they were in that case. But in California, in the course of three days of watching, on at least two occasions we saw a sea otter eating a short length of the thick tubular part of *Cistocercus*, apparently with relish. Here again we may recall that Alaskan Eskimos use certain species

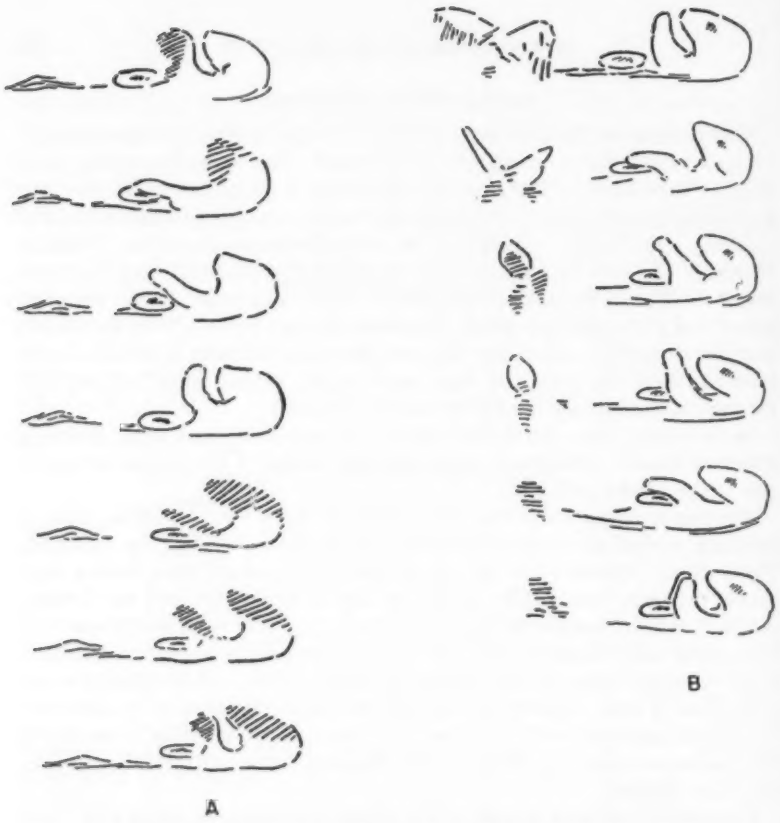


FIG. 1. Attitudes of California sea otter while breaking a mollusk on a rock. Free-hand sketches from 16 mm. Kodachrome film, made with the aid of a hand lens. These are accurate enough to show the essential features.

A and B are short sequences of 7 and 6 frames, respectively. The abrupt changes in some cases indicate the rapidity of the motion. (The pictures were taken at normal speed, 16 frames per second.) Note that in the A series there was blurring of the last three images. Since the apparent change in position of the paws in these three is very slight one wonders if these three blurred ones are not really recoveries from three distinct blows.

FIG. 2. A quartering view of the pounding action is shown in D, while in C the animal is feeding in characteristic manner subsequent to breaking the shell. The object used as an anvil in these pictures was light colored, with a dark patch in the center.

of seaweed for food. If a significant number of sea otter droppings from California ever become available for study, comparisons will be instructive.

HERDING

In California the sea otters normally gathered in a dense herd to rest during the day. At feeding time they scattered, returning later to the same vicinity, where they were usually seen in the characteristic aggregation.

In Alaska this habit was much less noticeable. On a very few occasions I found a group resting together as they do in California, though not so close together and relatively few in number, perhaps 15 to 20 at most, usually not so many. Generally they were found singly along the coast or in small scattered groups. At one time we estimated that we were seeing an average of ten sea otters to a mile of coast line, though the animals were not uniformly distributed. A mother with its young, or two or three mothers with young in one limited area; a single adult, or several in sight at one time in a given kelp bed; such was the usual experience. From one viewpoint, with field glasses sweeping along the line of visible kelp beds, I have counted as many as 20 or 30, some of them quite distant.

Whether or not a concentration of favorite food, such as abalone in California, is conducive to closer herding is hard to say.

YOUNG

There was a striking difference in the matter of young. Among the southern sea otters, in July, very young animals were not observed. Those which appeared to be young of the year were fairly well grown, more or less uniform in size, and seemed to be independent of their mothers. At least they were seen to go off by themselves to feed. They had acquired the sleek dark coat of the adult.

On the other hand, in Alaska at the same season (latter part of July and early August) there were young that obviously were of various ages. Some were fairly large, comparable with those seen in California, but apparently more or less dependent on the mother. At least mother and young were usually together. Others were small, with the characteristic chubby appearance and the straw-colored pelage, lightest on the head. These younger ones would lie on the mother's body as she floated on her back and would nurse or simply curl up to sleep. When danger threatened the mother would seize the little one in one arm and swim rapidly away, or if danger seemed imminent she would hastily dive with it, still grasping it with one arm.

BREEDING

Breeding was not observed on the California coast. In Alaska it was observed once. On July 23, 1936, Mr. Williams and I observed a pair at Ogliuga Island. The mother with her little one and a male were rolling about

at the outer edge of a bed of kelp. Presently the two adults disappeared under water. The little one swam back and forth, crying for its mother. After some time, perhaps about 10 minutes, the adults, clinging together, appeared on the landward side of the wide kelp bed, rolling over and over, and worked their way into the open water near shore where we were taking pictures at 50, 30, and 20 feet distance. Although we did not take note of the time, I believe we observed them for nearly ten minutes.

The two animals continued to roll, clinging to each other, the essential position apparently being with the ventral surfaces apposed, although of this I could not be positive for the relative positions were constantly shifting. They would submerge for a time, coming up with noisy expulsion of breath, only to roll over and under again. The female apparently got breath only as opportunity offered, sometimes after a long interval, since she was submerged much of the time by the activity of the more aggressive male. The male held her by the head with his teeth, sometimes grasping her upper jaw, once by her lower jaw, sometimes by the loose skin about her head. Sometimes the female held the male with her teeth. Occasionally the abdomen of the female appeared at the surface and I could plainly see the two mammae and well-filled udders.

In the meantime the little one, which had lost sight of the adults, was still crying at the far edge of the kelp, until at length the adults worked their way out there, having become suspicious of our presence, and the mother rejoined her offspring.

On a number of occasions in the last week of July and the first week in August a male sea otter was seen in the company of one or two females. A male and two mothers with their young had hauled out on a rock at one time. Another time a male climbed on a rock to join a female and her young. Sometimes it appeared that a male repeatedly sought the same female in the same place. The female paid little attention to the male, as if taking his presence for granted, indicating some degree of permanence in their relationships.

The female had only a single young in every instance observed. Her limited facilities in rough water and her habit of carrying and handling the little one under various handicaps would preclude her caring for more than one young.

PLAYFULNESS AND AFFECTION

Much has been written about the sea otter's playfulness. We obtained the same impression of this trait in Alaska but it was mainly confined to the actions of mother and young, and of course these manifestations would be mingled with those of parental affection. Mother and young would climb out on a rock and roll and squirm over each other. Often the mother would lick the fur of her little one for some time. When climbing on a rock the

mother sometimes had forcibly to persuade her offspring to follow. The unruly little one would persist in sliding back in the water and the mother would finally seize it in her teeth and drag it up with her.

When finished with feeding, the mother may settle to rest, floating on her back. The little one would climb aboard and nurse while she perhaps dressed its fur around the hindquarters. Or the youngster might simply curl up for a nap on its mother's abdomen.

It is interesting to call to mind the playfulness of the river otter (*Lutra*). It enjoys the sport of coasting down a snowbank. The habit of rolling in the water, so characteristic of the sea otter, might well be a manifestation of the same enjoyment of smooth motion. In the midst of feeding, even when a stone shell-cracker is balanced on its chest, a sea otter may have its meal interrupted by a side roll in the water. The meal is resumed, with the rock still in place, when the animal again rights itself. This is done so smoothly and quickly that the meal hardly appears to have been interrupted. Again, the land otter in the zoo will repeat diving and swimming maneuvers with apparent enjoyment. It is my opinion that both kinds of otters enjoy such graceful motions as these and indulge in them in the spirit of play.

HAULING OUT

In California we did not observe a sea otter on shore. We occasionally saw them on shore in Alaska; and, of course, the history of the early sea otter hunting period indicates that the animals habitually went ashore at times. According to the natives, sea otters go ashore during the terrific winter storms, when one is sometimes caught at a disadvantage in the surf and is killed.

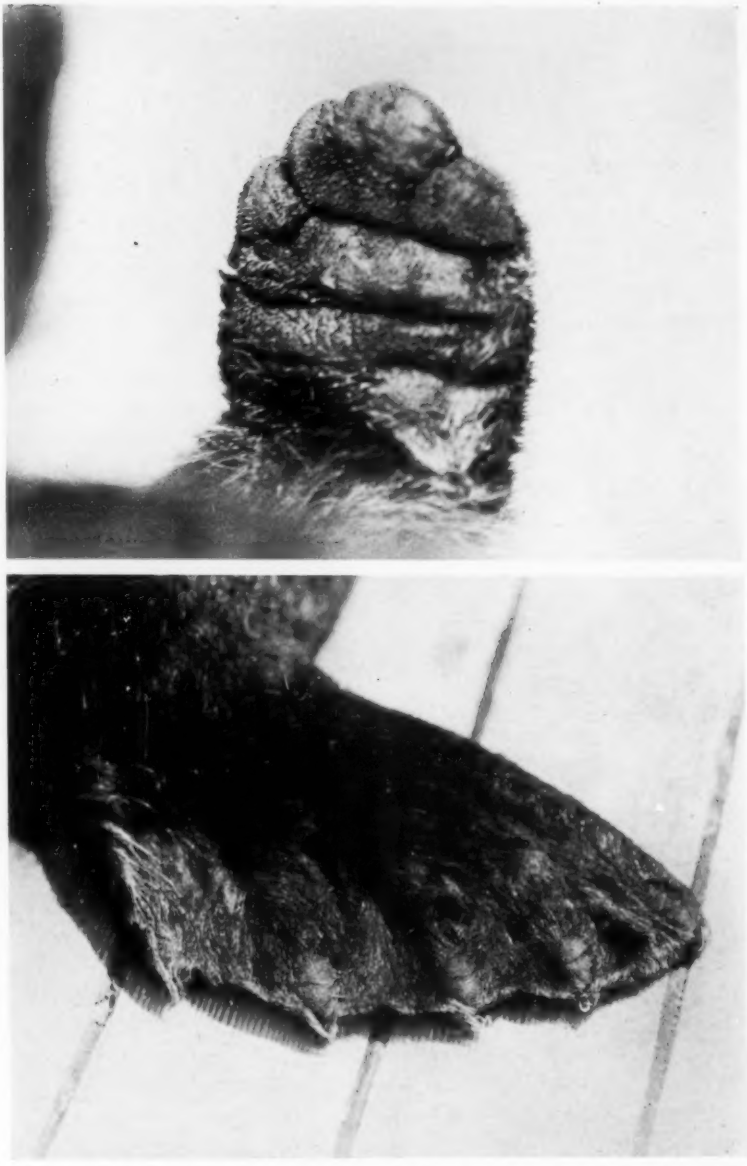
Reference has been made to instances when the mother and young were seen going up on rocks. Occasionally a lone male was seen sleeping on a rock, sometimes long enough for its fur to dry.

These animals have favorite hauling-out places, indicated by the accumulation of droppings. Such places were protected from heavy seas, either by a long rocky point or by a series of rocks on the lee side of an island. Often the otters clambered out on kelp-covered rocks that would be submerged at high tide, and certain individuals would return to the same place day after day. One rock that was so utilized in the summer of 1936 was still used regularly during our visit in 1937.

It may be pointed out in passing that the best habitat is furnished by a broken shore with scattered offshore rocks and reefs and abundant kelp beds. The Sanak Islands, for example, consist of a great number of islets scattered about a few larger ones, thus furnishing considerable shelter from storms. This was one of the most important sea otter hunting grounds in earlier times, though none of the animals occur there now.

UPPER.—A sea otter mother and young resting on a kelp-covered rock. Ogliuga Island, Alaska, August, 1936.

LOWER.—Sea otter scat. Ogliuga Island, Alaska, August, 1936.



UPPER.—Under surface of left front foot, showing the firm pad and rigid state of this member. Ogliuga Island, Alaska, August 4, 1937.

LOWER.—Under surface of right hind flipper of sea otter, showing the callous area near tip of each toe. Ogliuga Island, Alas' , August 4, 1937.

FIG. 3. A. Sea otter tracks in dry, loose sand. Ogliuga Island, Alaska, July 23, 1936. The variations in shape are caused by the loose texture of the sand. The middle hind track is typical of the manner of walking, as observed and photographed.

B. Hind and front tracks in the same trail. Toes are only dimly indicated and tips are no doubt obscured by loose sand.

THE SEA OTTER ON LAND

The sea otter does not feel at home on land and only goes there for short periods, as related above. Recalling that the hind feet are well-developed webbed flippers, specialized for swimming, and that the front feet are specialized for handling hard shells, with a hard calloused pad and with toes no longer separated and mobile, we may expect to find that the animal is not nimble afoot.

Some writers have thought that in walking the animal doubles the long webbed hind toes under and that consequently it actually walks on its "knuckles." Observation proved this not to be the case. The animal places its whole flipper forward, sole down. Motion pictures of the action clearly demonstrate this. The hind flipper is furred on both sides but has small callous spots at various joints on the under side of the toes.

Apparently the sea otter seldom goes ashore on a sandy beach, but at least one instance of this occurred. The sand was rather loose, but the tracks again indicated the same method of placing the hind feet as shown by the motion pictures and by direct observation.

THE PRESENT POPULATION RECOVERY

The come-back of the sea otter is one of the pleasant surprises of recent years. One of the hopeful features of the situation in Alaska is the wide distribution of the animal. There are two or three concentrations in the Aleutian Islands; but individuals and small groups have appeared, at long intervals it is true, along the entire length of the Aleutian chain and the Alaska Peninsula. With protection, these animals should become as abundant as in the past.

Biological Survey, U. S. Department of Interior, Jackson, Wyoming.

EARLY LIFE OF A SEA OTTER PUP

By Edna M. Fisher

This is the story of the early growth and activities of a pup southern sea otter, *Enhydra lutris nereis*, that I observed during the summer of 1939, using a 6-power and a 12-power pair of binoculars, and watching the animals at distances ranging from 200 feet to a mile offshore. Adult sea otters are about 5 feet in length and the smallest pups near 15 inches.

The nursery is located in a large bed of kelp, probably *Macrocystis pyrifera* (L.) Ag., which lies well offshore, and in turn is surrounded by large areas of the tubular kelp, *Nereocystis luetkeana* (Mert.) Post. and Rupr., sometimes called sea otter cabbage. In all of the illustrations for this paper the size of the *Nereocystis* has been dwarfed in proportion to the otters in order not to obscure the animals. Many of the floats of the *Nereocystis* are as large as an adult sea otter's head. When massed they make a perfect hiding place for the otters.

There are many visitors to the nursery, as other otters are constantly moving back and forth from one herd to another. As far as could be discovered these visitors are mainly adults and subadults, stopping to rest and feed. The permanent members of the nursery group are mothers and their pups, pregnant females, a few other females, and possibly three or four males.

Sea otters give birth to their young at any season, as demonstrated by the constant presence of pups and cubs of various sizes. The term "pup" is used for the young as long as they are covered with golden brown woolly hair; after they lose this and get the adult type of fur and coloring they are called "cubs" until they reach adult size. The members of the next age group are called "subadults." These are the young that are of adult size but not sexually mature. The births of the young otters take place on the kelp beds.

August 21, 1939, the birth-cry of a baby otter was heard far out on the kelp, but distance and weather conditions made even the 12-power binoculars useless at the time. The next day the baby and his mother were found nearer shore where she was seeking for food on the rocks of the ocean floor. While she dived and hunted for some wandering abalone or unlucky clam, Junior was left to float on the surface in a tiny pool in the midst of the big tubular kelp, whose leaves, floats, and stems perfectly matched the color of his fur.

Junior floated on his back with his head, arms, feet and tail up, and his lungs well filled with air; he rode high in the water while waiting for his mother (fig. 1). Every time his mother returned to the surface she always went to him to make sure that her offspring was safe. A sea otter mother takes her maternal responsibilities very seriously and keeps a close watch on her offspring at all times until it is fully grown. The male is not interested.

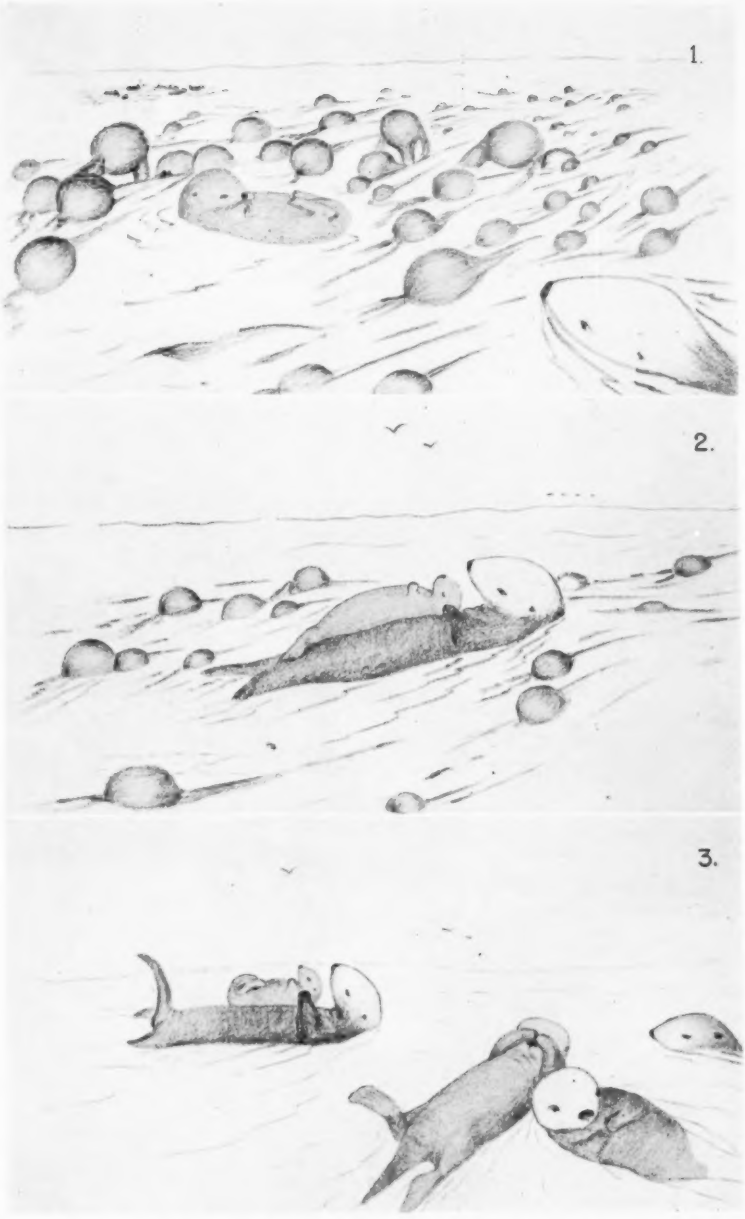


FIG. 1. The baby floats high in the water while waiting for his mother
FIG. 2. The mother reaches her baby and with her paws rolls him on to her chest
FIG. 3. The mother takes the baby back to the main herd

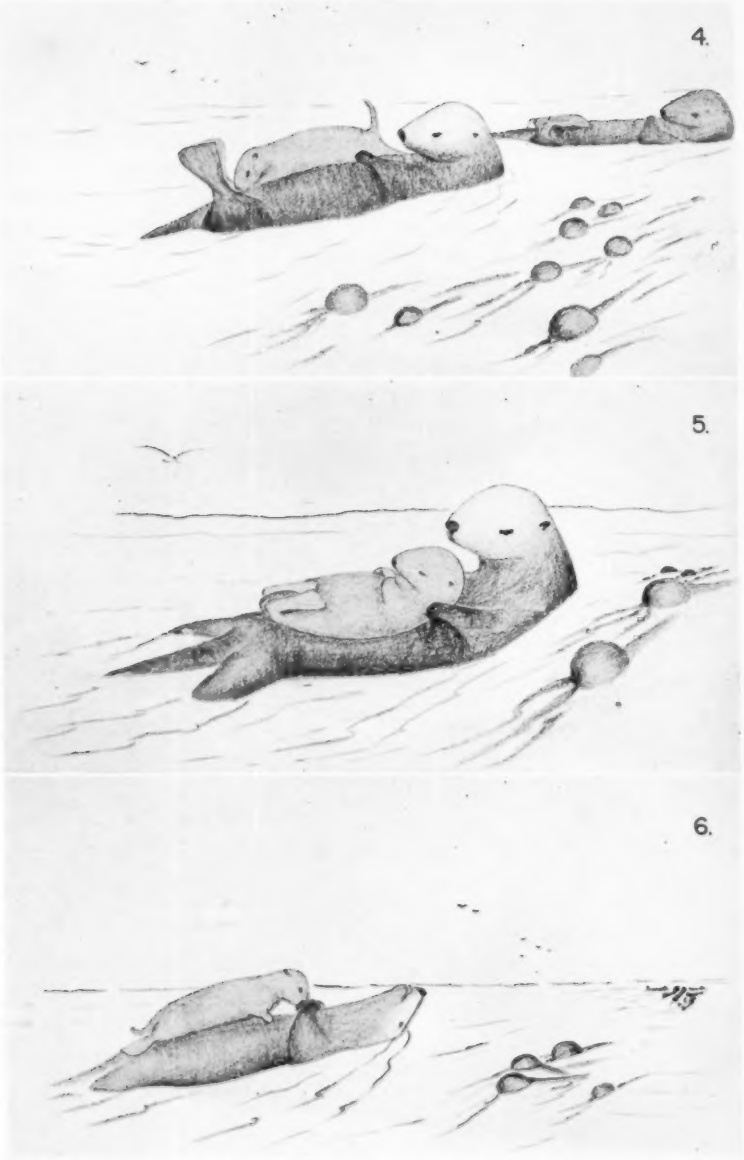


FIG. 4. With the mother's assistance the baby is turned around in position for nursing
FIG. 5. The baby sleeps on his mother's breast
FIG. 6. The baby climbs on the mother's chest to eat the food she holds for him

The mother, giving up hope of finding any food materials in one location, comes to the surface, rises up in the water and shakes vigorously, then lies back in the water and swims over to her baby, and with her paws rolls him on to her chest (fig. 2). She then swims to the northeast to better feeding areas, threading her way carefully through the small channels between the masses of kelp. The mother carefully holds her baby out of the water on her chest as she paddles along on her back, frequently turning her head, the better to choose her course. Her big webbed hind feet are used alternately to push her through the water and over the kelp. When she finds a suitable area she leaves the baby to float in a small open space while she dives for food. The mother does not share any of this food with Junior at this early stage. Her favorite food materials are the red abalone, *Haliotis rufescens* Swainson, and the large sea urchin, *Strongylocentrotus franciscanus* (A. Agassiz). To these are frequently added crabs, several species of clams, and perhaps a few very small surf fish; also some other things too small to identify.

After the mother has had enough to eat she again takes Junior on her chest and slowly swims back to the main herd (fig. 3). When at home again in the smooth kelp, Junior decides that it is time that he had some food. With his mother's able assistance he is turned over and around so that his hind feet are near his mother's head (fig. 4). The mother's two mammary glands are located between her hind legs. After the feeding, Junior is again rolled around and for the next few minutes he undergoes a thorough cleaning. The mother cleans her baby's long woolly hair as a cat cleans her kitten; only the otter mother does a much better job of it. The pink tongue of the mother licks the hair over and over until she is satisfied that all tangles and debris are removed. She also frequently uses her teeth on the longer hair and especially in cleaning Junior's paws and feet. During this cleaning process she rolls Junior first one way and then another, over and around until he is thoroughly cleaned. That the mother is not gentle in her cleaning activities is evidenced by the frequent complaints uttered by the pup.

Cleaned up and full of food, the pup is now ready to go to sleep. He sleeps with his head on his chest and his tiny paws folded across his chest; his short tail and long webbed feet are turned up and rest on his abdomen, all in all forming a compact golden brown mass on his mother's chest. The mother uses her paws to hold him in place until he is sound asleep, then slowly and quietly she sinks into the water leaving Junior floating on the surface sound asleep. She comes up nearby where she floats and cleans her own dense fur. The baby drifts and dreams in the quiet pool, rocked only by the long gentle swells that pass through these acres of kelp. Junior may sleep for a few minutes or perhaps for the better part of an hour. While he sleeps his mother does nothing that might awaken him (fig. 5).

Several days pass, and Junior has grown and his personality has become more marked. The mother takes him on her chest and starts southeast to

seek food. But when only a short distance from the home kelp bed she rolls him off into the water and, leaving him, swims ahead. This large clear pool is free of kelp so that Junior cannot cling to a kelp stem until his mother comes after him; he must either try to swim after her or float on his back until she comes for him. Naturally wanting to go with his mother he tries frantically to swim after her, but his back muscles are very weak and all he does is to kick up water while his back is arched high out of the water and his head and chest are under the surface. He soon tires and quits struggling, although his mother has been swimming around him and away and back again as though to give encouragement to his efforts. After the struggle he turns over on his back to rest and breathe. Not seeing his mother near he utters sharp complaining "meows" until she returns and takes him on her chest to ride to the feeding areas. If she comes to another quiet pool she may roll him off again and repeat the swimming lesson.

When she arrives at the desired feeding area the mother leaves Junior in a tiny pool to play on the kelp and practice back-up swimming. She dives many times but only a few times does she bring up food. After each dive she returns to her pup to make sure that all is well with him. If she dives in the pool in which Junior is playing, then he too tries to dive, with the result that his head and neck go under water, but he cannot get the rest of himself under, no matter how hard he tries. But he soon forgets the diving and tries to swim across the tiny pool with his back up. The back muscles are still weak and although he manages to get across the pool he cannot get his head up out of the water. So he must roll over and float and rest and breathe. If his mother comes up a short distance off, Junior may try to dash to meet her, showing his great joy at seeing her with a sudden burst of speed that results in his frantically kicking much water into the air and getting nowhere.

Although Junior still nurses, his mother shares various food materials with him. Every once in awhile she brings up something that Junior likes very much, for instead of floating and eating what his mother gives him, he gets so excited that he then climbs out of the water and sits on her chest while he eats the food she holds for him (fig. 6).

Once more with full stomachs, they slowly return to the main sea otter herd. At home again Junior is thoroughly cleaned. He then sleeps quietly beside his mother; or she may hold his head on her chest, while his body floats, until feeding time again.

After a few weeks Junior has learned to swim back-up with some success. He is now able to follow his mother to the feeding area and he requires fewer rides during the journeys. Mother swims slowly on her back, keeping close watch over Junior because he has now learned to play by the wayside. Such stops on the part of Junior usually result in punishment of some kind, depending on how persistent he is in this trick. Although the mother swims

slowly, Junior must exert himself to keep up with her. If by accident he gets left too far behind he cries until his mother returns to him. At such a time she may take him on her chest and give him a ride or merely take him in tow. If Junior is too slow to satisfy his mother she may haul him onto her chest and give him a ride for some distance, while Junior wags his short tail up and down, fairly pounding his mother's abdomen with it.

During the journey the mother makes brief stops to dive down, exploring the rocks below. Junior remains on the surface because he has not yet learned to dive. The pup spends much time climbing on the large kelp stems; when he reaches a float he tries to jump off and dive. But much to his surprise he only comes up on the other side of the float. So he tries again and again to dive; sometimes he loses his balance and rolls off the kelp stem before he reaches the float. When tired of this game he may lie on his back and wait for his mother's return. If mother has been successful in her hunting she may tear out a mouthful and give it to Junior, or, after tasting it, she may give it all to him. He floats on his back and chews until he has finished it; then he seeks his mother for more. Or he may be temporarily satisfied and resume his playing on the kelp stems.

In this way they move slowly from place to place, feeding until their hunger is satisfied and then returning to the large kelp bed in which the other otters rest. The stops on the return journey are usually less numerous than those on the outward trip. Once returned to the main kelp bed they again rest and clean. Mother cleans her own fur and goes over Junior's quite thoroughly. Junior always tries to be of assistance and to help in cleaning his shaggy coat.

2410 Fulton Street, Berkeley, California

HABITS OF THE PACIFIC WALRUS (ODOBENUS DIVERGENS)

By Grenold Collins

The Pacific walrus, formerly abundant in Bering Sea south to the Pribilof Islands and Cape Newingham, has now been almost exterminated in the southern portion of its range.

The present range of this walrus extends from the southern fringe of the ice pack in winter in the general vicinity of St. Matthew Island to the Siberian coast in the vicinity of latitude 62° and also to a lesser extent eastward in the area between St. Lawrence Island and Nunivak Island. In summer the range extends northward to Point Barrow, Alaska. Walrus are reported as more numerous at all times on the Siberian side of the Bering Sea and Arctic coasts than they are on the American side.

MIGRATORY MOVEMENTS

After spending the winter in the Bering Sea and near the adjacent Siberian coast, the great herds of walrus move northward with the general drift of the ice pack during the months of May, June and July. They arrive at St. Lawrence Island in May, pass King Island in the early part of June and are in evidence at Diomede Islands about the same time. The herds pass Point Hope in early July and reach Point Lay and the big clam beds of Icy Cape about the middle of July. Their movements north of Icy Cape depend largely on the ice conditions.

The natives from Wainwright usually hunt walrus about the first of August. At Point Barrow the Eskimos hunt them until the first part of September. Usually most of the walrus taken off Barrow are bulls. It is believed that the females and young linger in the vicinity of Sea Horse Island until they start south.

Walrus do not go east of Point Barrow along the Arctic coast, but swing north and west from Barrow and the Sea Horses and then drift south toward the Siberian side with the ice and current. It is said by those who formerly traded along the Siberian coast in summer that the walrus also drift north in summer along that side to North Cape in larger numbers than on the American side. In fact, in the old days the walrusing schooners used to hunt along the Siberian side because the herds were larger and more numerous there.

As the animals move west and south from the Alaskan Arctic in the fall, very few are in evidence on the southerly migration until they reach Bering Strait. They are seen and heard passing through the narrow passage between the Big and Little Diomedes in late fall. Natives do not kill many at this time because the animals are in the water, but they report that the straits are sometimes jammed with walrus for two days and nights, swimming south. Others, it is said, drift south with the ice; but it is believed that large num-

bers swim south from Bering Strait in advance of the ice to reach the feeding grounds in the vicinity of East Cape and the adjacent Siberian coast.

BREEDING

The walrus have their young as they drift north on the ice floes during the month of May and early June. The young are very much in evidence when they reach King Island in early June. Breeding takes place in June and early July during the northward migration. I found embryos in the females killed at Point Lay about the 13th of July. The embryos ranged in size from 1 inch to 5 inches in length. I believe that the gestation period of the walrus must be at least 11 months. It seems from observation that the breeding of these animals and time of birth vary to some extent. The young walrus that I saw at Point Lay in July were about the size of small harbor seals. The Eskimos sometimes kill them for use in making rope. In measuring one at Wainwright on August 28, I found the length to be 3 feet 10 inches and guessed the weight to be about 120 pounds.

Walrus seem to show a strong family instinct and considerable devotion to their young. They have no thought for their own safety when defending the young. At Icy Cape, after the Eskimos had killed 6 walrus on a cake of ice, the herd came to the edge of the ice many times, bellowing and fighting, and the Eskimos had a hard time to drive them away and prevent the boats from getting smashed. Eskimos have told me of many exciting adventures with walrus when the young have been molested. The females do not hesitate to charge bravely. On these occasions the hunters must haul their boats out of the water on the ice to save them. Occasionally the animals will become so enraged that they will patrol the vicinity where hunters are marooned for a long time, roaring defiance and menacing the natives by charging along the edge of the ice.

DESCRIPTION

The name "walrus" is derived from an old Norse word "valross," which means "whale horses." The adults vary in bulk from 2,000 to 3,000 pounds in weight and they are from 10 to 12 feet long. The female tusks are long and slender and curve inward at the ends with a bow at the middle. The male tusks are much heavier than those of the female and are often blunt or broken at the ends. The length of the male tusks is from 14 to 26 inches although tusks up to 36 inches in length are sometimes taken. Charles Brower at Point Barrow reports a pair of tusks that measured 39 inches. The male tusks weigh from 6 to 9 pounds each. The average large tusk is about 7 pounds.

HABITS

The animals spend a large part of their time lying and sleeping on ice floes. They seem to be lazy animals enjoying an easy existence. I have observed

them for hours at a time lying all over the ice and even piled one on top of the other. They sometimes lie on their backs with the tusks sticking straight up in the air and scratching themselves with their flippers. They are continually rubbing themselves with their flippers to discourage the "lice" which are numerous in the rudimentary hair and the folds of their skin.

They feed on clams and other mollusks which they dig from beds in the shallow sea. They also eat large quantities of a sea snail about 3 inches long. The stomachs when loaded with clams are about 3 feet long and the contents will fill a washtub. The Eskimos consider the half digested clams and snails from the stomachs a great delicacy. The stomachs of 60 walrus killed near Icy Cape were empty and although the animals were close to the extensive Icy Cape clam beds they were not feeding. As the animals observed at that time were very quarrelsome, I believe that they were still breeding and not eating, although they were in fat condition. When they reach Wainwright they always have full stomachs.

Social instincts are strong as the animals gather in large herds in the water and on the ice. When they become too crowded on the ice they will strike at each other with their tusks and often push each other into the sea. Sometimes when there is a limited amount of room on the ice, these animals will pile up on top of each other until the ice becomes top heavy and sinks or tips over, dumping hundreds of the great beasts back into the sea. When breeding, the bulls can be seen fighting with their tusks. They become scarred, bruised and warty from this fighting.

Late in July 1938, a large herd of walrus hauled out on the beach at Point Hope and Cape Lisbourne. They came right into the village and almost a hundred were shot there by the natives. These evidently got too far behind the northerly drifting ice and became so exhausted from swimming that they had to go ashore at Point Hope. When hauling out under these conditions, they do not stop for anything short of gun fire.

The walruses spend their lives feeding in the clam beds, breeding and sleeping on the ice as they drift north and south with the current. However, being good swimmers they move swiftly through the water. I observed them haul out in the following manner: They hooked their tusks in the edge of the ice and pulled themselves up far enough to get a front flipper on top of the ice. Then they crawled out on the ice by holding with the tusks and walking on the flippers and sometimes "hunching" themselves over the steep places.

When the hunters approach the edge of the ice where these animals are sleeping, the sentinel gives the alarm with a loud whistling bellow and all the animals scramble into the sea. As the boats are being pulled out on the ice, the walrus rise all about the edge, bellowing, blowing through their nostrils and rearing their heads high. The attitude is very threatening and they are evidently trying to scare the hunters away.

Usually walrus are timid but occasionally they get excited and attack a

boat. If the tusks are driven through the bottom of the boat, the natives plug it with a shirt or any handy article. If the tusks are hooked over the side of the boat, the natives sometimes avoid disaster by grabbing the tusks in their hands and shoving the boat out from under with their feet. Otherwise the boat will be overturned and the natives drowned.

Although a walrus is awkward on ice or land, it is reported that when one charges a man on level ice, the man must run quite fast or be overtaken by the animal before he reaches the boat.

The baby walruses travel through the water by holding fast to the neck of the female with their flippers. They ride along in her wake while she is swimming and diving.

ENEMIES

Beside man, the only enemies of the walrus are killer whales and polar bears. The bears occasionally kill the young.

The killer whale is the worst enemy of the walruses, often killing them in great numbers. These killings are frequently observed in the vicinity of the Diomede Islands. It is reliably reported that 3 years ago, a large herd of walrus was driven ashore by killer whales in the vicinity of Panuck, St. Lawrence Island. The frightened animals piled up on top of each other in such great numbers while hauling out on the beach that over 200 of them were smothered and crushed and left dead on the beach. These carcasses were used by the Eskimos.

All the natives and other observers report that there is an occasional "outlaw" walrus. Such an animal is very large and has very small sharp tusks that tend to stick out sideways. These animals sometimes stay in the Arctic during the winter and are always avoided by the other walrus if possible. These outlaw animals live on seal and anything else that they can kill and devour. Such "outlaws" have been killed at St. Lawrence, Diomede, and Point Barrow during winter. Seal meat has usually been found in their stomachs. Otto Geist personally observed this on St. Lawrence Island.

UTILITY

These animals are a very important factor in the lives of the native people wherever they can be hunted.

The Eskimos at St. Lawrence, King and Diomede islands use walrus meat and fat for food and keep from one to two years supply stored in caves. They use the skins to cover their houses and also for boat covers and rope. The ivory is utilized for tools and ivory carving. The ivory is sold raw for 60 cents a pound, and also carved and sold or traded for supplies and white man's food.

The natives of the Arctic coast hunt walrus chiefly for meat and dog food, selling the ivory to traders. The King and Diomede islanders are almost totally dependent on walrus for their existence.

HUNTING METHODS

In former times, the natives hunted walrus by harpooning from skin boats, kayaks, or lancing on the ice; now they use high-powered rifles. Along the Arctic coast the operations are carried out in the following manner:

The natives use a launch or whaleboat powered by an outboard motor to tow a string of skin oomiaks out along the ice pack offshore to the areas where the animals are hauled out on the ice. They locate them, in spite of the almost continual fog that hangs over the ice, by listening for their roaring whistle, which sounds somewhat like the baying of a hound dog heard from a distance.

Walrus swimming in the water also lead the natives to the places where the great herds are congregated. Walrus in the water seem very wary and hard to approach but on the ice they seem stupid and easily approached. When the boats have worked their way in among the large pods of walrus hauled out on the ice, the Eskimos select a small group of the animals for killing. It would be too dangerous to make a kill where several hundred are congregated.

When a small group has been selected on some flat ice that is favorable for cutting up the carcasses after the kill, the natives tie up their boats and several stay behind to protect the boats from the animals in the water. The hunters make ready an oomiak and after saying a prayer, they paddle to the group of walrus. The three or four hunters in the bow of the boat do the shooting. As the boat approaches to within 15 or 20 feet of the walrus, the men talk in low tones. This talking seems to keep the herd from becoming alarmed. As the boat approaches, the animals rear themselves erect.

At a signal, the men in the bow open fire, aiming to hit the beasts in the neck just below the back of the head. When the shooting starts, the walrus charge into the sea; soon the ice is clear of all except the dead ones. The natives then paddle for the ice and haul the oomiak out. One man runs over to the walrus with a rifle and shoots those not quite dead to keep them from moving and perhaps slipping into the water.

The walrus that have escaped into the water come charging around the ice, roaring and splashing. The natives wave their hands at them to scare them away. If females or young have been killed, the herd will return to the vicinity of the kill time after time and the natives have a busy time to keep them from wrecking the boats.

The next operation is to cut up the dead animals and load the meat and blubber into the boats. The carcasses are cut open with axes and knives and the skeleton is taken out. The bones are thrown into the water. The meat and blubber that is left is cut into squares and loaded into the boats. Occasionally an animal is skinned when skin is needed to make rope, boats or houses. The skins used for boat covers are split by the women. The tusks and flippers are also saved and the intestines are sometimes used to make

windows for the houses, or to make floats and clothing. From four to five walrus can ordinarily be loaded into the average oomiak boat.

At King Island the natives hunt walrus by getting on the ice floes and approaching them on foot. To kill a walrus in the water, they first wound the animal by shooting it in the back so it will not sink and then harpooning it before shooting to kill.

It is reported that the Eskimos at Indian Point, Siberia, kill walrus by going amongst the herds hauled out on the beach or on the ice and lancing them with spears or knives. They do not allow the use of rifles because they believe that this would drive the animals away from that vicinity.

When the shooting method is used in hunting walrus, a few of the animals, merely wounded, get into the water and are lost. The natives then make every effort to save them by harpooning. Animals that sink often drift ashore later on and are used by the natives for dog feed and trap bait.

PRESENT ABUNDANCE

It is known that walrus were being rapidly depleted for many years until they were in danger of extinction from persecution by whalers and ivory hunters. However, after the decline of whaling operations these interesting animals began to increase again until they are now quite plentiful throughout their range. The general opinion of the great majority of those in position to observe this species, is that it is now holding its own and is in no present danger of extinction. If ivory hunting is not extensive and if the Russians do not encourage the slaughter of walrus, it is possible that the great herds now existing can be maintained.

ANNUAL KILL

Subsequent inquiry has shown that the figures on the annual walrus kill submitted from Barrow are too high. Instead of representing the average kill, they represent the largest possible kill at the various places under favorable conditions. I believe that the following figures are more nearly correct for the average kill:

Nunivak Island—Hooper Bay	50
St. Lawrence Island	300
King Island	300
Diomede Island	250
Nome—Wales—Shishmaref	75
Point Hope	75
Point Lay	75
Wainwright	100
Point Barrow	75
Total	1,300

As nearly as I can figure from the data on hand the ordinary yearly kill of walrus by Alaska natives ranges from 1,000 to 1,500 animals. Father La-

Fortune, a long-time resident of Diomede Island, thinks that the total annual kill in Bering Straits by both Alaska and Siberian natives is less than 2,000.

The population of the Straits Islands is about as follows:

	People	*Dogs*
Little Diomede	120	50
Big Diomede	12	—
East Cape, Siberia	500	600
King Island	190	60
St. Lawrence Island	390	200

The people of the Straits Islands store walrus meat and blubber in caves and usually keep from one to two years supply in storage.

Biological Survey, U. S. Department of Interior, Seward, Alaska.

A SURVEY OF THE MAMMALS OF THE ISLANDS IN GREAT SALT LAKE, UTAH

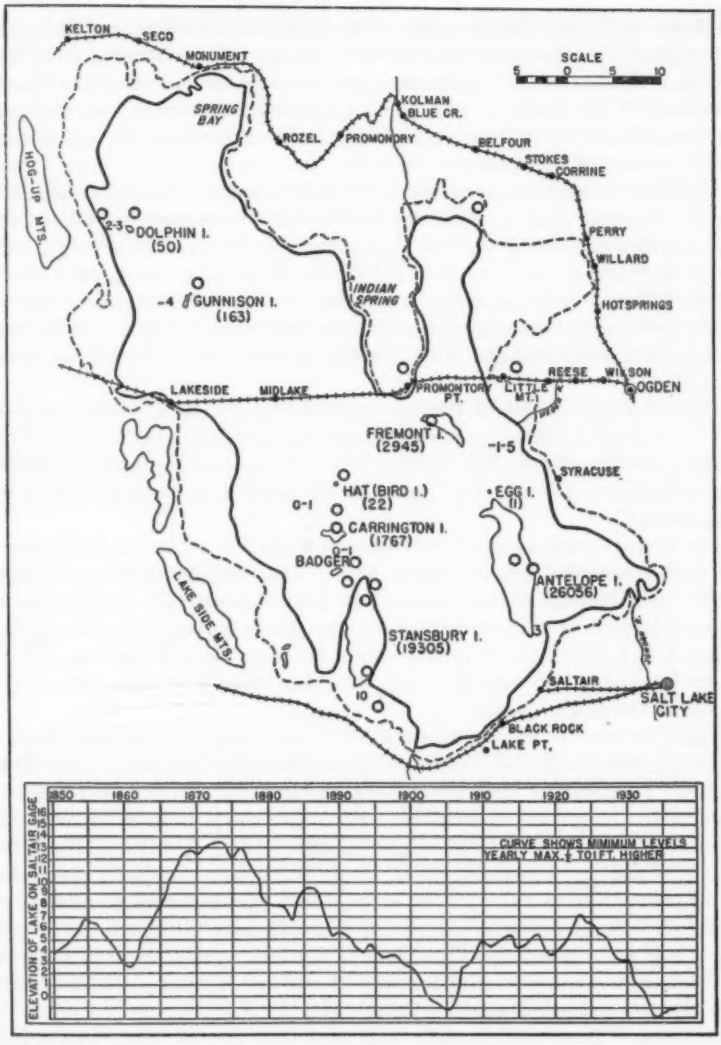
By William H. Marshall

Despite the fame of the desert islands in Great Salt Lake, Utah, as the site of bird-nesting colonies, little has been recorded about the mammal fauna of these islands. Mammal collecting carried on by A. M. Bailey and Robert J. Niedrach, and by the author on Gunnison Island in 1937 stimulated interest in a survey of the islands, which was carried out in 1938. Goldman (1938 and 1939b) has described the new forms then collected. The present article and a bird list to appear independently present ecological and distributional phases of the survey.

The field work was carried on mainly during the summer of 1938, with three days in 1937 on Gunnison and Bird islands, and sixteen days on other islands and five on the adjacent mainland in 1938. Besides setting traps and collecting mammals, we made notes on the birds and on the plant life. Continual attention was given to geological features for correlation with Gilbert's descriptive treatise of 1890.

The map (fig. 1) indicates by ○'s the localities where collecting was done.

Dr. D. I. Rasmussen, of the Utah Wildlife Cooperative Research Station, and Lee Kay, of the Utah Fish and Game Department, stimulated my interest in the area in 1937 in connection with the annual census of bird rookeries. Dr. Rasmussen has assisted also by critically reading the manuscript; and the Research Station provided office and laboratory space in 1938. L. J. Leatham, E. O. Chatelain, and R. J. Jansen, students at the Utah State Agricultural College, served as field assistants at various times; Major E. A. Goldman, of the United States Bureau of Biological Survey, made the taxonomic determinations of the materials obtained; A. D. Smith, Assistant



Map of Great Salt Lake, showing shore line as determined by Stansbury, 1850, and elevation of lowest point on connecting bars of islands.

Shoreline is 4 feet on Saltair gage. Zero on this gage is 4196.8 feet above sea level. Elevation connecting bars refer to this level. Figures in parentheses indicate acreage of islands.

Correction.—In place of -1-5 insert -1.5.

Professor in Range Management at the Utah State College, verified many of the plant identifications; and Dr. T. C. Adams, of the University of Utah, provided all the data on height, area, and the connecting bars of the islands. Members of the Predator and Rodent Control Division in the Biological Survey and owners of the islands gave valuable information on animals and on the history of the islands.

Published records of mammals on these islands are both scarce and scattered. Captain John C. Fremont (1850) visited Fremont Island in 1843 and was disappointed by the dearth of animal life; Howard Stansbury (1852), in his fascinating report on the exploration of the lake, commented briefly on the larger animals; Ridgway (1877) discussed a concentration of rabbits; Behle (1935) noted the white-footed mouse on Gunnison Island; and Durrant (1936, 1939) and Goldman (1937, 1939b) reported on the results of recent collecting.

Published discussions of the physiography and climate are of interest. Gilbert's work of 1890 presents an analysis of the geological features, Alter (1936) summarizes essential climatic data, Adams (1932) describes present-day variations in the lake itself; and Eardley (1938) reports on a study of the lake bottom.

The average stage of Great Salt Lake is 4,215 feet above sea level; this is the lowest extensive area in western Utah. It is considered, to quote Alter, to be "the remnant of an ancient lake named Bonneville, the surface of which at its highest stage was a thousand feet above the present rather shallow Great Salt Lake." Davis (1933) points out that Lake Bonneville existed as such "during late geologic time, probably coincident with late glacial epochs of the glacier period."

There are now seven islands, so-called, in the lake, of which only three—Antelope, Stansbury, and Fremont—stood above the surface of Lake Bonneville. Furthermore, only a very small rocky peak of Fremont Island extends above the Lake Bonneville level. The rocks of these islands are pre-Cambrian or Paleozoic in origin (Eardley, 1938, p. 1312). The other islands—Dolphin, Gunnison, Bird, and Carrington—probably appeared above the waters as Lake Provo, a long-lived (375-foot-lower) remnant of Bonneville, finally receded. Davis (1933, p. 12) says, "although the present Great Salt Lake is usually taken, at first thought, as a remnant of its great predecessor, it is quite possible that a very arid and lakeless period may have been reached as Lake Bonneville shrank away. . . ."

In addition to the islands, two small sand bars of very recent origin harbored mammals. One is locally known as Badger Island and is so designated on the map (fig. 1). The other, situated between Bird and Carrington islands, is not named on the map. Both these will be discussed in remarks on mammal distribution.

The severity of the climate, which undoubtedly influences the differ-

entiation of subspecies, is indicated by the data in Table 1. The averages cited must be taken with some reservations, as a few miles horizontally or feet vertically may be associated with tremendous variations in rainfall. The data for Kelton and Midlake, however, may be taken as indicative of conditions of Dolphin, Gunnison, and Bird islands; those for Saltair to a great degree probably represent conditions on the other islands.

Salt Lake average annual evaporation for three years was 63.45 inches, with a monthly maximum of 13.03 inches in July.

HABITATS

Certain fairly well-defined types of habitat, which were not studied except by casual observation, were found. As these proved of interest in connection with the occurrence of mammals, they will be briefly described.

TABLE 1.—Climatic Data, taken from tables in Alter (Climate of Western Utah, 1936)

STATION	SITUATION	ELEVATION	ANN. PREC.	AV. ANN. TEMP.	AV. MAX. TEMP.	AV. MIN. TEMP.	HIGH TEMP.	LOW TEMP.
Kelton	North shore	4,225	6.63	46.2	61.3	31.4	114 July	−27 Feb.
Midlake	Center of lake	4,218	6.34	52.8	58.4	47.0	98 June	3 Jan.
Saltair	South shore	4,220	14.02	51.1	59.4	42.9	99 July	−9 Jan.

(1) *Salt water.*—Adams (1932) wrote that the area of the lake at zero level on the Saltair gage is slightly more than a million acres, its average depth 13 feet, and the maximum recorded depth 35 feet. The "stages" indicated on the graph in figure 1 fluctuate through the years and also vary within the year as spring run-off and summer evaporation raise or lower them.

Eardley (1938, pp. 1330–1333) summarized the present knowledge of life in the salt water of the lake. Such life is entirely invertebrate and microscopic in character, with a few exceptions, such as the brine shrimp. Human beings experience pain when the water gets into their eyes and nose while swimming in the lake, because of the high salt content of the water (25–30 percent). Thus, although buoyance is great, mammals might soon become choked or blinded by salt during wind storms. Little is known of currents in the lake but they are probably chiefly the results of wind. Thus during calm periods logs would move little and animals upon them would suffer from prolonged exposure. There are few streams entering the lake that might be expected to provide logs for the transport of mammals and these are all on the east side where they might bring immigrants to Fremont and

Antelope Islands. Ties and timbers from the Lucin cut-off, built in 1911, were the only pieces of drift found during the present field work. These were dropped during the period of construction, 1910–30, and there is small chance that any mammals were on them at the time of their release into the water.

(2) *Salt "flats".*—Eardley (1938) discussed this habitat in great detail. For the purposes of this paper it may be referred to as white "marl," apparently deposited through the ages, and forming the bottom of the lake. Varying areas are exposed as the lake rises and falls. Some of these form dry-land connections between the islands and the mainland. Only Gunnison has been an island in the strict sense of the word continuously since 1850. A well drilled at the Bear River Migratory Bird Refuge in 1937 showed the "marl" deposits to be at least 520 feet deep. The surface is practically flat, and the material has a very high salt content. The flats are not impassable barriers to all mammals, and the heights of the bars between islands compared with the known fluctuations of the lake furnish a basis for calculating the periods of connection, and hence of possible influx of mammals. By correlating such data with the occurrence of species and subspecies, animal movements can be demonstrated and the "role of insularity in the evolution of species" (Goldman, 1939b) studied.

(3) *Sand bars.*—Each of the islands is surrounded by a sand bar (referred to as "bluffs" by Eardley (1938, p. 1315), which is usually most extensive to the southeast because of the prevailing northwest winds of recent times. Most of these bars are built to a level of about 10 feet above the zero of the Saltair gage. Certain higher bars on Stansbury and Antelope Islands (pl. 1) support groves of juniper (*Juniperus utahensis*) that are undoubtedly several centuries old, but most of the bars were probably deposited more recently.

The majority of the bars support *Sarcobatus vermiculatus* and *Atriplex confertifolia* most frequently, with *Chrysothamnus nauseosus*, *Oryzopsis hymenoides*, *Artemisia spinescens*, *Menziesia* spp., *Allenrolfea occidentalis*, and *Distichlis stricta* present in some places.

(4) *Benchlands.*—The islands are largely made up of benches formed at different levels of the prehistoric lakes. Eight such levels were readily distinguished on Stansbury Island. Gilbert says that as many as thirteen have been detected in one particularly favorable place. The soil of the benches is chiefly gravel, with some rock outcrops.

The abundance of plants varies from island to island. On Dolphin Island, *Artemisia spinescens*, *Atriplex confertifolia*, and *Sarcobatus vermiculatus* were perhaps dominant, and *Opuntia engelmanii*, *Erigeron* spp., *Bromus tectorum*, and *Eriogonum tenellum* were also present. On Gunnison and Bird islands, *S. vermiculatus* and *A. confertifolia* were abundant, and some *B. tectorum* also occurred. Carrington Island, which according to sheepmen has had few fires, has extensive areas of *Bromus tectorum* on the west exposure, while on its eastern slopes there are several areas of *Oryzopsis hymenoides*

PLATE 1

UPPER.—Juniperus utahensis grove on sandbar at the northern end of Stansbury Island.

LOWER.—Sagebrush benchlands at the northern end of Stansbury Island. Three benchlines are prominent here.

and *Agropyron spicatum*, with some patches of *Artemisia tridentata*. The greater part of the benches on Stansbury Island (pls. 1 and 2) supports stands of *A. tridentata* as well as various grasses and herbs, among which *Poa longiligula*, *P. spicatum*, *Bromus tectorum*, *Eriogonum caespitosum*, and *Allium* spp. were noted. Similar plants grew on the corresponding areas of Antelope and Fremont islands, except that on these latter islands there was a larger proportion of areas covered by *B. tectorum*.

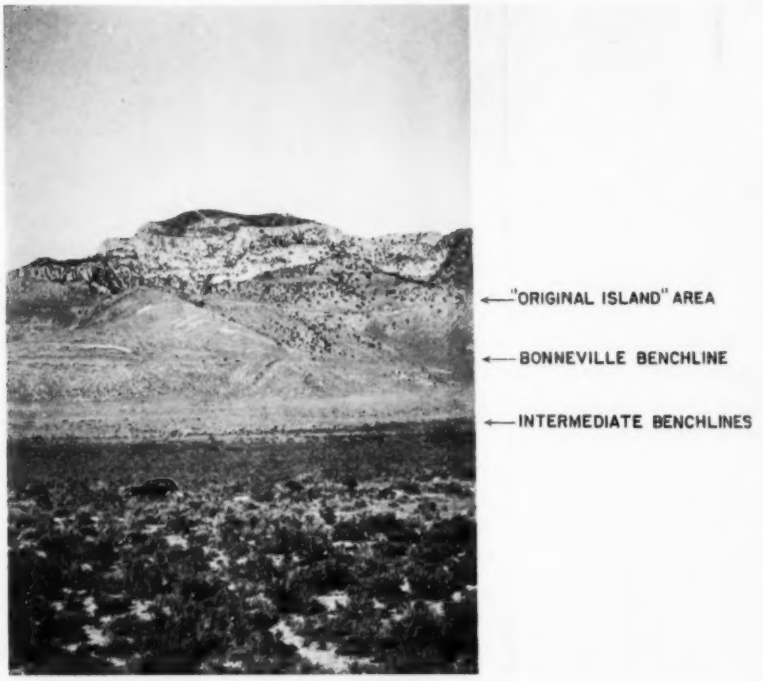


PLATE 2

View of the highest point on Stansbury Island and the benchlands at its base

(5) *Original islands.*—This habitat, practically confined to Antelope and Stansbury islands, is found on those parts of the three islands that always projected above the highest level of Lake Bonneville. It is characterized by extensive growths of the mountain-mahoganies, both *Cercocarpus montanus* and *C. ledifolius*. *Juniperus utahensis*, *Pinus edulis*, and *Pseudotsuga taxifolia* were found scantily on northern exposures of Stansbury Island. *Amelanchier* sp., *Rhus trilobata*, *Gutierrezia sarothrae*, *Stipa comata*, *Agropyron spicatum*, *Allium* sp., and *Astragalus* spp. also were found.

(6) *Springs.*—Palatable water is present only on Antelope Island, where at least eight springs make conditions favorable for the growth of *Acer negundo*, *A. glabrum*, and *Salix* spp., together with such herbs as *Urtica* spp., and *Rumex crispus*, which grow profusely. The Dooley ranch, said to have been established in pioneer days, is irrigated from several of these springs and has a small field of alfalfa, an apple orchard, and a grove of poplars.

Brackish springs are found at the edges of the sand bars and salt flats on Fremont, Antelope, and Stansbury Islands. They have dense growths of *Scirpus paludosus* and *Distichlis stricta* about them. These springs are suitable only for watering stock.

THE NORTHERN ISLANDS

Two small islands, Gunnison and Dolphin, are situated north of the Southern Pacific Railroad "Lucin cut-off." They are of interest in yielding newly described subspecies; and, when contrasted with each other, they show the effects of different lengths of isolation.

Dolphin Island, with an estimated area of 50 acres, has been connected with the nearby Hog-up Mountains for 20 of the last 90 years. Two new subspecies of kangaroo rat—*Dipodomys microps russeolus* and *D. ordii cinerascens*—were found on the island. On the other hand the populations of *Peromyscus maniculatus sonoriensis*, *Citellus townsendii mollis*, and *Canis latrans lestes* do not differ from the mainland stocks. The inhabitant of the single woodrat's nest found on the island was too wary for the collectors; but a specimen of *Neotoma lepida* was taken on the adjacent mainland. Coyotes cross from the mainland frequently, as shown by tracks in the salt flats. The skull of an immature animal indicated that there might have been a coyote den on the island at one time.

On the morning of June 6, 1938, a ground squirrel was observed out on the salt flats about 2 miles from the island and running toward it. The animal appeared to be very determined to reach the island. In fact, we had difficulty in scaring it in any other direction. When allowed to proceed, it maintained a bee line for the island for as long as it could be seen. This ground squirrel and the coyote tracks were the only direct evidences obtained of mammals moving across the salt flats.

On the 50 acres of Dolphin Island there were four "family" groups of ground squirrels, each consisting of five or six individuals. On the sand bars, *Dipodomys ordii cinereus* was abundant. Only one *D. microps russeolus* was captured and that on benchland.

The dried-up body of a porcupine (*Erethizon epixanthum*) was found on the island. The animal had probably wandered from the Hog-up Mountains. Single porcupines have been seen several miles out on the salt flats near the Bear River Bird Refuge.

Gunnison Island, to the south of Dolphin Island, has been continuously

isolated by salt water since 1850. Its bar, at −4 feet in relation to the zero on the Saltair gage, is the lowest connecting link between any of the islands and the mainland. Here specimens of only two mammals—*Dipodomys microps alfredi* and *Peromyscus maniculatus gunnisoni*—were taken in 1937 by Bailey, Niedrach, and the writer. Goldman (1937, p. 222) says that the kangaroo rat most closely approaches "*D. m. celsus* of northwestern Arizona in size" and "might be treated as a distinct species." The white-footed mouse, "in general size and proportions shows alliance to *P. m. sonoriensis*." Thus the former, as will be seen from later discussion, tends to become differentiated from the mainland forms, in contrast to the white-footed mouse that is widely distributed through the islands. It may be that at times the lake has been low enough to expose the bar between Gunnison and the mainland and that the white-footed mouse has crossed more frequently than the kangaroo rat.

THE WESTERN ISLANDS

To quote Eardley (1938, p. 1309), "A peninsula is almost formed by Carrington Island and Stansbury Island. . . . Stansbury Island is actually a peninsula except at very high water level. It is probably a northward extension of the Stansbury Mountains. Although Antelope and Stansbury Islands are often not surrounded by water, they are truly islands from a geological standpoint because they are masses of pre-Cambrian or Paleozoic bedrock surrounded by lake sediments of Pleistocene or Recent age." In addition to Stansbury and Carrington, two other islands are situated in this grouping: Bird Island, the northernmost of the group, and a sand bar locally known as Badger Island. Collecting was done on the mainland side of the bar connecting Stansbury with the mountains to the south. These four islands have in common three subspecies: *Dipodomys ordii marshalli*, *Peromyscus maniculatus sonoriensis*, and *Canis latrans lestes*. The kangaroo rat differs from that trapped on the mainland side, but the white-footed mouse and coyote do not.

Bird Island, the northernmost of the chain, is only 22 acres in extent and is the site of a colony of white pelicans, California gulls, and blue herons. The mouse population, practically confined to the rocky-beach habitat, is very large. Thirty-two individuals were taken in 31 traps on the night of June 30, 1938. Only two kangaroo rats were caught in 12 traps that were examined three times during the night. The scarcity of the kangaroo rats may have been due to the severe rainstorm that washed the island the day before; kangaroo rat abundance was indicated by many old workings in the sand bar.

According to Goldman (1939a), there is no reliable difference in color between the specimens of *Peromyscus maniculatus sonoriensis* taken on Bird Island and those obtained on Carrington Island. A slight color difference,

however, was noted in the field; and the skins of the series from Bird Island could be readily separated from those of Carrington Island on that basis. Should the lake rise again, continued isolation might increase the differentiation of these animals.

One very interesting catch made on Bird Island in 1937 was a common house mouse (*Mus musculus*). Until it was recalled that at one time tourist excursions to this island were frequent, the catch was a mystery. Undoubtedly this animal had escaped from some package brought to the island. No house mouse was taken a year later when trapping was carried on at the same place.

Coyotes have made their way to the island frequently and are said to have been responsible for diminution in the bird colony during recent years. The logbook on the island contains a notation that one party ran 15 coyotes off the island on March 22, 1935.

Two *Peromyscus* captured while I was walking from Carrington to Bird Island are of particular interest. Midway between the islands were two sand bars about 6 inches in elevation above the salt flats and scarcely 50 yards in diameter. At that time they were cut off from Carrington by water, but not from Bird Island. The distance to Carrington is about 2 miles, whereas Bird Island is somewhat closer. From the chart in figure 1 it would seem that the bars had been in existence only since 1931 and that they had been connected with the nearby islands since 1932. The only vegetation was a scattered stand of *Dondia* sp. One mouse was caught on each bar. These proved to be a male and a female of *P. m. sonoriensis* and were similar in color to those from Bird Island. This observation shows that white-footed mice extended their range at least 1½ miles across the salt flats at sometime during 6 years.

Carrington Island, at the middle of the western group, has an area of 1,767 acres and is 5 miles north of Stansbury, with Badger Island about midway between. On Carrington we found seven mammals, in contrast to three on Bird Island and twenty on Stansbury. All the animals found here are present also on Stansbury. Three—*Canis latrans lestes, Sylvilagus nuttalli grangeri*, and *Peromyscus maniculatus sonoriensis*—are undifferentiated from the mainland stocks; but *Dipodomys microps subtenuis, D. ordii marshalli, Neotoma lepida marshalli*, and *Perognathus parvus plerus* are differentiated.

The mammal populations were of interest aside from these contrasts which indicate the relative isolation of Bird Island. Eighty-six percent disturbance of traps placed at random for three nights indicates a high population of small rodents. Wood rats had constructed nests over almost every available log and rock and in nearly every crevice on the island; five specimens were obtained by tearing the nests down by day. On Stansbury Island it was difficult to corner wood rats by this method, as they had built nests where there were a number of paths for escape. Because of nearly complete occu-

pation of the available sites on Carrington, many of the nests were in "vulnerable" spots. In contrast to wood rats, cottontails were scarce, only two being seen after arduous hunting. L. E. Stoddard, of Hooper, informed me that the sheep herders hunted the rabbits during the winter for food. Coyotes have caused losses of sheep on this island during times of low lake stages, but when the water is high enough to isolate the island, herders are not necessary and no losses occur.

Badger Island, a sand bar about 6 acres in extent, which lies between Carrington and Stansbury islands, has apparently been exposed since about 1889. For 20 years before then it was undoubtedly under water. Twenty trap nights were recorded on June 30, 1938, when *Peromyscus maniculatus sonoriensis*, *Dipodomys microps subtenuis* and *D. ordii marshalli* were taken. Fourteen white-footed mice were obtained, indication of a dense population confined to a thicket of *Sarcobatus* and *Atriplex* in the middle of the island. Few signs of kangaroo rat burrows were found. Three wood rat nests were noted, but there were no fresh signs around or in the nests. The tracks of *Sylvilagus nuttalli grangeri* and *Canis latrans lestes* were seen. Sheepmen in Grantsville reported that a den of coyotes was destroyed on this island a few years ago. Thus, this area has harbored at least six subspecies—all being the same as those on Carrington and Stansbury islands.

Stansbury Island, previously mentioned as being the least isolated of the areas studied, had by far the greatest number of subspecies. A large proportion of these are common to the mainland. A specimen of the newly described *Reithrodontomys megalotis ravus* was obtained near Grantsville as well as on Stansbury Island. The wide-ranging *Peromyscus maniculatus sonoriensis* was generally distributed over the island. *Citellus townsendii mollis* was very abundant on the lowest bench and on the sand bars. *Lepus californicus deserticola* had a similar distribution and an even greater population density. The cottontail was abundant on the benchlands. W. R. Hale, Biological Survey predator animal hunter, trapped two coyotes (*Canis latrans lestes*) and liberated one badger (*Taxidea taxus taxus*) on this island in 1929, and in 1937 he trapped seven coyotes and one bobcat (*Lynx rufus uinta*), and liberated one badger. One coyote den and fresh badger signs were found in 1938. One adult doe mule deer (*Odocoileus hemionus hemionus*) was seen in the "original island" area of mahogany brush, on June 24, 1938, and on the next day unmistakable signs of the porcupine (*Erethizon epixanthum epixanthum*) were found on several piñon pines near the north end of the island. Sheepmen reported that chipmunks (probably *Eutamias minimus pictus*) were abundant four or five years ago, and that skunks (*Mephitis mephitis major*) are present. We did not, however, observe these animals.

Subspecies differing from those reported on the mainland were: *Dipodomys ordii marshalli*, *D. microps subtenuis*, *Perognathus parvus plerus*, *Onychomys leucogaster utahensis*, *Thomomys bottae minimus*, and *Neotoma*

lepida marshalli. Goldman (1939a) states that the newly described *Peromyscus crinitus praegracilis*, which was collected on Stansbury Island, represents a species that had not been previously reported from nearby areas.

Sand bars of the mainland directly opposite Stansbury yielded in one night's trapping *Peromyscus maniculatus sonoriensis*, *Reithrodontomys megalotis ravus* and *Dipodomys ordii utahensis*, thus contrasting with Stansbury only in the subspecies of kangaroo rat. Other mammals, including *Neotoma lepida lepida*, *Dipodomys microps bonnevillei*, *Perognathus parvus olivaceus*, and a pocket gopher, probably *Thomomys bottae albicaudatus*, have been recorded from this mainland area.

About 90 years ago Stansbury reported "wolves" [probably coyotes], deer, and antelopes (*Antilocapra americana americana*), on the island; the antelopes have not occurred there recently. One wonders why he did not mention such readily observed animals as the ground squirrel and the jack rabbit.

The numbers of the animals on this island are of interest chiefly as a contrast to those noted for Antelope Island. The mule deer, porcupine, coyote, badger, and bobcat are undoubtedly scarce; probably not more than four or five individuals of each were present in the summer of 1938. The grasshopper mouse, harvest mouse, pocket mouse, and black-pouched kangaroo rat were found at both ends of the island, but few specimens were taken. The white-footed mouse, wood rat, pocket gopher, white-cheeked kangaroo rat, ground squirrel, and jack rabbit were abundant. Of these, the white-footed mouse and the wood rat were taken in all the habitats, the pocket gopher only on the highest or Bonneville bench and the "original island" areas, where its workings were found in great numbers, and the other three only on the sand bars and the lowest of the benches. Of the species reported by earlier observers, the antelope has been extirpated, the chipmunk is said to have been abundant four or five years ago. Because of the scarcity of marshy areas there are probably few skunks.

Ridgway (1877, p. 371) relates that one of the sand bars to the south of Stansbury was "named Rabbit Island on account of the large numbers of hares (*Lepus callotis*) [now *L. californicus deserticola*] that were found on it." He visited the place on June 11, 1869, and described it as "merely a low knoll occupying scarcely an acre in extent." Reference to the graph of the stages of the lake (fig. 1) shows that June, 1869 was near the end of a period of steady rise in the lake level. Evidently this sand bar was the highest of the extensive series south of Stansbury and the rabbits were caught by the rising water.

THE EASTERN ISLANDS

Antelope and Fremont islands lie in the southeastern part of the lake. When their faunas are compared they further demonstrate the effects of isolation. These two islands have had the only human habitations of any

of the islands in the lake. Fremont Island has some peculiarities that may possibly be explained by its lying nearest the mouth of the Bear River.

Antelope Island, the largest in Great Salt Lake (area 26,056 acres), is separated from the mainland by 3 miles of bar of plus 3 feet elevation. Several mammals have been introduced. A bison herd of 350 animals was built up here in the 1920's when the island was used in filming the motion picture "The Thundering Herd." In 1933 a small group of these animals crossed the flats and appeared near the town of Bountiful about 15 miles to the east; but they were afterward herded back to the island. Their numbers have since been reduced by hunting and sales because the range they used was needed for sheep; in 1938 only 34 remained.

Three other introduced mammals are the domesticated dog and cat and the house mouse. The mouse was abundant about the ranch. Antelopes (*Antilocapra americana americana*) probably were native to the island but were extirpated. In 1920 eight fawns were brought to the island from Wyoming; only one lived. It was a pet at the Dooley Ranch for 8 years. Mule deer (*Odocoileus hemionus hemionus*) imported from the Kaibab herd of Arizona at about the same time also failed to survive.

The coyote (*Canis latrans lestes*) and the bobcat (*Lynx rufus uinta*) have at times been abundant on the island. The Biological Survey carried on predator extirpation work in the early 1920's, when apparently the animals were wiped out. In 1933, however, sheep losses began again and further killing was necessary. In connection with the recurrence of coyotes in 1933, it may be significant that for the first time in many years the bar connecting Antelope Island with the mainland to the south was exposed during a short period in 1931 and 1932. One coyote was seen in 1938.

Skunks (*Mephitis mephitis major*) were common about spring areas on the east side of Antelope Island, sixteen being seen and one collected. One was seen on the west side in 1937. One adult male weasel (*Mustela frenata nevadensis*) was caught in a pocket gopher hole at the Dooley Ranch. These animals were reported as being common about the springs.

In contrast to results on Stansbury, only thirteen jack rabbits (*Lepus californicus deserticola*) were seen and one collected on Antelope Island. A small number of ground squirrels (*Citellus townsendii mollis*) were observed on the west shore of the island in 1937, but none on the east side. Cottontails (*Sylvilagus nuttalli grangeri*) were reported as scarce but none was seen or taken. Woodrat (probably *Neotoma lepida lepida*) sign was found in one place only, but no specimens were collected. Fresh pocket gopher (*Thomomys bottae nesophilus*) sign was noted only in the alfalfa field at the ranch. Although diligent search was made in habitat similar to that in which *T. bottae minimus* was found on Stansbury, no other workings were discovered. In addition, *Peromyscus maniculatus sonoriensis* and *Dipodomys ordii utahensis* were collected, though the frequency of disturbance of traps was only 58 percent.

Thus we find that Antelope Island, with a relatively high bar and in-

habited by man since pioneer days, has a fauna like that of the adjacent mainland with the addition of certain introduced species. Considerable predator extermination has been carried on in this area, but even so a surprisingly low population of rodents was found.

Fremont Island has been, next to Gunnison, the most isolated island of the group. It has been connected with the east shore of the lake for only 3 years since 1850 by a bar that must total 20 miles in length. It presents two anomalies in mammal distribution that may be linked with its position in relation to the fresh water of the Bear River.

Coyotes do not occur on the island; therefore sheep can be run all winter without herders. A new subspecies of white-footed mouse (*Peromyscus maniculatus inclarus*) was found, indicating relatively complete isolation of the island. No sign of kangaroo rats were seen or specimens taken at the west end of the island, a faunal deficiency not found at any other locality.

In contradistinction, jack rabbits (*Lepus californicus deserticola*), though scarce, were present; one specimen was taken. Furthermore, Stansbury cited the discovery of a "single ground squirrel" (probably *Citellus townsendii mollis*) in 1899 and marveled at its presence on the island.

L. E. Stoddard, of Hooper, Utah, who runs sheep on the island, said that in the winter of 1933–34, ice and debris from Bear River jammed up between Fremont and the mainland to the east, and he thought the rabbits came across at that time. At least there were none before then. The rabbits are active at the edges of the lake during the winter, when most other mammals are inactive. The squirrel seen in 1849 might have been a fortuitous immigrant brought down on a log by the Bear River at flood. The formation of ice at the mouth of this river shows that the water is less saline than that in the remote sections of the lake. Thus, a few rabbits because of their winter activity, and by chance a ground squirrel, might have made their way to Fremont Island when other animals did not.

Collecting was done in 1938 at both the nearest "mainland" points—Promontory Point and Little Mountain (Weber County). Here were taken: *Perognathus parvus olivaceus*, *Dipodomys ordii utahensis*, *Peromyscus maniculatus sonoriensis*, *Neotoma cinerea cinerea*, and *Sylvilagus nuttalli grangeri*. Thus the *Peromyscus maniculatus inclarus* of Fremont Island is closely approached on all the nearest mainland points by the widespread *P. m. sonoriensis*.

SUMMARY

(1) Islands having the highest and shortest connections with the mainland yielded the greatest number of mammalian genera, species, and subspecies.

(2) Islands having the lowest and longest connections with the mainland produced the least number of genera, species, and subspecies.

(3) The least isolated islands have the greater proportions of mammalian subspecies in common with the mainland, and the most isolated islands have more subspecies differentiated from those of the mainland.

TABLE 2.—Summary of data on islands

ISLAND	(1)[3] AREA	(2)[2] HEIGHT (ABOVE 0 ON SALTAIR GAGE)	(3) PROBABLE AGE	(4) HEIGHT OF CONNECTING BAR (ABOVE 0 ON SALTAIR GAGE)	(5) NEAREST CONNECTED AREA	(6)[2] DISTANCE	(7)[3] YRS. CONNECTED SINCE 1850	(8) NUMBER OF MAMMALIAN SUBSPECIES COLLECTED	(9) ADDITIONAL MAMMALIAN SUBSPECIES REPORTED	INTRODUCED SPECIES	TOTAL NUMBER OF MAMMALIAN SUBSPECIES	SUBSPECIES DIFFERING FROM THOSE ON MAINLAND
	Acres	*Feet*		*Feet*		*Miles*						
Dolphin	50	60	Less than 20,000 yrs.	+2 or +3	Hog-up Mts.	3–4	1898–1908 1930–1938	4	3		7	2
Gunnison	163 (GLO)[1]	150	" "	−4	Hog-up Mts.	15	None	2	—		2	2
Bird (Hat)	22	40	" "	0 to +1	Carrington Is. Lakeside Mts.	5 20	1901–1906 1931–1938	2	1	1	4	1
"Sand bars"	½	2	6 yrs.	0 to +1	Carrington Is. Bird Island	2½ 1½	1931–1938 1931–1938	1	—	—	1	—
Carrington	1,767 (GLO)	400	Less than 20,000 yrs.	0 to +1	Stansbury Is. Lakeside Mts.	4.8 20+	1901–1906 1931–1938	5	2	—	7	4
Badger	6	10	50 years	+1	Carrington Is. Stansbury Is.	2 2.8	1900–1906 1931–1938	3	3	—	6	3
Stansbury	19,305 (GLO)	2,500	pre-Bonneville	+10	Oquirrh Mts.	½ salt flats. 12 total	1850–1866 1878–1938	12	8	—	20	8
Antelope	26,056 (GLO)	2,398	" "	+3	Oquirrh Mts.	3¼	1860–1862 1898–1908 1931–1938	6	8	6	20	—
Fremont	2,945 (GLO)	796 (GLO)	" "	−1.5	Weber County (Hooper)	15+	1905? 1934–1935	2	1	—	3	1

[1] GLO = General Land Office Data.
[2] Column numbers (1), (2), and (6) are estimates.
[3] Column number (7) from Number 4 and fig. 1.

(4) The highly mobile coyote has been found on most of the islands. Next in extent of insular distribution is the white-footed mouse (*Peromyscus maniculatus sonoriensis*), which is known to have moved over the salt flats for a considerable distance in a short time.

(5) In contrast, two subspecies of pocket gophers are restricted to the islands upon which they were discovered.

(6) The new forms exemplify a tendency toward paleness in this desert area.

The indications are, therefore, that mammalian distribution on the islands has been chiefly dependent on the ability of the animals to move over the salt flats and on the availability of connections between the islands and the shore.

It is apparent from the geological history of the area that the mammalian subspecies peculiar to the islands (other than Stansbury or Antelope islands, which have never been submerged) have developed during the last 20,000 years. Isolation by salt water and salt flats has probably been of prime importance in their evolution.

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Column number (7) from Number 4 and fig. 1.

LIFE HISTORY NOTES ON THE PIUTE GROUND SQUIRREL

By J. R. Alcorn

The Piute ground squirrel (*Citellus townsendii mollis*) takes its common name from the Piute Indians who have used it for food since the time of earliest accounts left by white men of Nevada and according to Indian legends for countless years before. I first became aware of the importance of these animals to the Indians when I was carrying on poisoning operations in the desert near a ranch east of Fallon, Nevada. An elderly Indian drove up in a dilapidated wagon. He was a large, heavy-set man, and at first glance I knew that he was "on the war path". The conversation between us began as follows:

"Indian: What you doin'?

J. R. A.: We are killing squirrels.

Indian: Who tell 'um you to kill squirrels?

J. R. A.: Many ranchers have asked the government to kill the squirrels because they are doing damage to crops. My boss has given me instructions to do the work.

Indian: Me boss too, me chief. I tell 'um you stop now.

J. R. A.: I couldn't do that.

Indian: I get sheriff after you. You better stop now; today. It's agin th' law to kill 'um squirrels. My people starve without squirrels. . . ."

Everything considered, it seemed best to stop operations. I summoned my ten C. C. C. assistants and we moved to another location to finish the day's work. Many of the boys, who were fresh from New York City, were much impressed by this first meeting with an Indian.

In June of any year it is a common sight to see an old buggy, drawn by a small pony, laden with numerous containers for carrying water, one buck Indian and several squaws. Often the Indians have traveled for several hours from the Reservation to find a place where the squirrels are numerous and close to water. At this place the squaws carry water from a few to several hundred feet and pour several buckets-full into a burrow. The buck Indian catches, by the neck, the squirrel that is forced out of the hole. If the squirrel is thin it is usually turned loose; if fat it is either killed or placed alive in a sack or box. Sometimes the squirrels are eaten within a few hours after they are killed; but Indians often take live squirrels many miles to trade or sell to other Indians.

In June, 1937, I came upon two Indians who had several hundred live squirrels in the back of an old automobile. These two men, about twenty-four years of age, and obviously of some education, said that they themselves did not eat the squirrels, but had caught them to take to Pyramid Lake, fifty-five miles away. There they would sell the squirrels to other Indians for ten cents each or three for twenty-five cents. These two Indians said

that they had made from five to twenty dollars a day in this way. According to them the "old timers" were better customers than younger Indians.

The younger generation of Indians who eat these squirrels usually dress them and use modern methods to cook them but the "old timers" do not. These old Indians bury the squirrels in hot coals. After the hair has burned off, the squirrel appears to be burned so much as to be unfit for food. However, when it is taken out of the fire one finds that only the skin is burned and that the meat and fat, the only parts eaten, are nicely roasted. I have eaten squirrels prepared in this way and in the modern way. Prepared by either method they are of good flavor and so fat as certainly to be highly nourishing.

It is possible that Indians for generations have taken squirrels of this species from one valley to another and there liberated them in an effort to insure a stable food supply. In this manner the Piute ground squirrel may have come to occupy a range of larger size than it normally would have had.

Close observation of these squirrels in the territory within ten miles of Fallon, Nevada, was undertaken in the spring of 1936 and continued into the summer of 1939. For part of this time I was supervising control measures directed at this squirrel by the United States Bureau of Reclamation in coöperation with the United States Bureau of Biological Survey, employing poisoned rolled oats distributed by C. C. C. enrollees. For the remainder of the time, I made observations in connection with work on my own ranch.

HIBERNATION AND AESTIVATION

The squirrels emerge from hibernation in February while the weather is still severe. The earliest dates on which they were found active in four consecutive years are as follows:

Feb. 13, 1936. Four animals were seen when the weather was cloudy and when the extremes of temperature for the twenty-four hour period were 30 degrees and 53 degrees Fahrenheit.

Feb. 21, 1937. Eight animals were seen when the weather was clear and the extremes of temperature for the twenty-four hour period were 21 degrees and 50 degrees.

Feb. 14, 1938. Twelve animals were seen, when the weather was cloudy, a few hours after a trace of snow had fallen. Extremes of temperature for the day were 20 degrees and 43 degrees.

Feb. 15, 1939. Three animals were seen when the weather was partly cloudy and extremes of temperature for the day were 31 degrees and 48 degrees.

Male squirrels emerge from hibernation before the females. Examination of individuals that had recently come out of hibernation, revealed fat in the abdominal cavity of the males whereas the females had little or no fat. Of eight shot on February 14, 1938, all were males; five poisoned on February 17, comprised three males and two females; nine shot on February 27 were males;

twenty-three shot on March 3 comprised 17 males and six females; March 7, nine animals comprised five males and four females; March 9, 24 animals comprised 17 males and seven females. Additional information gathered in 1939 is in line with that just given for 1938.

The time of year when these squirrels go into aestivation appears to be directly correlated with the amount of food available. In years when there is a normal supply of food, the males, for instance, become remarkably fat within a period of approximately 120 days after emergence, at the end of which time they go into aestivation. When food is scarce they may remain active for a longer period.

One male kept in captivity was not given food enough to become very fat. Instead of aestivating, when others kept in captivity did, he continued feeding for 40 days more, at the end of which time he escaped by gnawing a hole in the screen of the cage.

Also, on several occasions, I have captured squirrels in the fall months after most of the animals were below ground and have found that these squirrels had no visible fat. My suggestion is that they are physiologically, as well as physically, not ready to hibernate because they lack sufficient fat.

In contrast to the males, which ordinarily require about 120 days to become fat, the females and juveniles are usually active about 135 days before they become fat enough to aestivate.

Once these squirrels go into aestivation, they normally stay underground for 7½ to 8 months before emerging in the following spring. If, however, the food supply is not sufficient to fatten the squirrel in 120 to 135 days, it may stay out longer, or may emerge for a time in the autumn after only a short period of aestivation.

The young of both sexes also fatten later than do the adult males, and, although they may not be full grown, they usually go into aestivation about the same time as the females, namely, in the first week of July. Although females that do not bear young fatten early, I do not know whether or not they go into aestivation as soon as the males. A person with a little experience is usually able to distinguish a male from a female in the period from April 15 until the squirrels go into aestivation. The males then are much fatter and, in the latter part of June, if pursued by a person on foot, they appear to have difficulty in running, which probably results from the large accumulation of fat. The females do not appear to accumulate as much fat as the males. They are especially active if pursued by a person on foot.

REPRODUCTION AND FLUCTUATION IN NUMBERS

Records of breeding habits for the year 1938 will now be described, because for that year they are the most complete that I have. Breeding apparently began between the fifth and twentieth of March. Evidence of this is shown by the enlargement of the uterine horns, observed at this time but not before.

The horns of the uterus in the inactive period are approximately one millimeter in diameter, whitish in color, and flexible. About the time breeding begins, these tubes become inflated and have the consistency of sponge rubber. I do not know if the enlargement of these tubes indicates that implantation has occurred. After these tubes are inflated, enlargements, indicating developing embryos, appear in them. At one of these enlargements the uterine tube is approximately two millimeters in diameter. It is firm, almost hard, and white in color.

On March 9, 1938, out of seven females shot, one had ten embryos and six had enlarged uterine horns. The presence of embryos in this one female was, for this year, the earliest evidence obtained that implantation had occurred. Of the many females whose reproductive tracts were studied in the breeding season of 1938, all of those examined on five selected dates are as follows:

Mar.	16,	1938.	9 embryos, 2 mm. diam.			Mar.	31,	1938.	8 embryos, 14 mm. diam.				
"	"	"	uterine horns enlarged			"	"	"	13	"	14 mm. diam.		
"	"	"	10 embryos, 10 mm. diam.			"	"	"	11	"	5 mm. diam.		
"	"	"	uterine horns enlarged			"	"	"	10	"	5 mm. diam.		
"	"	"	"	"	"	"	"	"	8	"	10 mm. diam.		
"	"	"	"	"	"	"	"	"	9	"	21 mm. diam.		
"	"	"	10 embryos, 2 mm. diam.			"	"	"	12	"	10 mm. diam.		
"	"	"	uterine horns enlarged			"	"	"	11	"	7 mm. diam.		
"	"	"	"	"	"	"	"	"	5	"	7 mm. diam.		
"	"	"	8 embryos, 2 mm. diam.			"	"	"	14	"	17 mm. diam.		
"	18,	"	9 embryos, 2 mm. diam.			Apr.	8,	"	16	"	19 mm. diam.		
"	"	"	uterine horns enlarged			"	"	"	young already born				
"	"	"	12 embryos, 4 mm. diam.			"	"	"	"	"	"		
"	"	"	10 embryos, 4 mm. diam.			"	"	"	"	"	"		
"	"	"	uterine horns enlarged			"	"	"	"	"	"		
"	"	"	"	"	"	"	"	"	"	"	"		
"	"	"	"	"	"	"	"	"	"	"	"		
"	"	"	11 embryos, 11 mm. diam.			"	"	"	11 embryos, 13 mm. diam.				
"	"	"	9 embryos, 4 mm. diam.			"	9,	"	young already born				

As indicating the length of the gestation period it may be pointed out that on March 16, 1938, implantation had occurred in 40 percent of the females and on March 18, in 60 percent. On April 8 and 9, 1938, 70 percent of the females already had given birth to young. This indicates that more than 20 days is required for gestation.

By combining all of my figures (MS) from the sixteenth to the twentieth of March for the two years 1938 and 1939, I find that implantation, as indicated by the presence of small embryos, had previously occurred in 23 of the total of 45 females, or in 51 percent. Of eighteen females examined between April 8 and 12 inclusive, in 1938 and 1939, 13, or 72 percent, were suckling young. This suggests that the gestation period is about 24 days.

Blind, pink, naked young squirrels, 15 in number, were found in a burrow excavated on April 8, 1937. About the same time (exact date not recorded)

another nest, containing 17 young in the same stage of development, was found.

Fewer young squirrels were produced in 1939 than in 1938, 1937, or 1936. On March 20, 1939, ten female squirrels were examined and only eight contained embryos. On April 12 and 18, 1939, ten female squirrels were examined and only two, or 20 percent, were suckling young; the other eight appeared to be barren. Further examination of 20 female squirrels in the later part of April, 1939, revealed that 60 percent were barren. It is not known why so few females bore young in 1939. In that year food conditions appeared to be normal and no extreme weather conditions were recorded.

In 1937 and 1938, when the population of these squirrels was at its peak, the examination of 207 females showed that 90 percent produced young. Furthermore, the squirrel population was observed to be large in those years. For example, the distribution of strychnine-coated rolled oats on two measured acres, each judged to support an average-sized population, yielded 120 and 134 dead squirrels above ground. This was in April, when young of the year had become active above ground, but contrasted sharply with the smaller numbers found in similar work in 1939, on favorable areas not before treated with poisoned grain.

During 1939, when the population of squirrels apparently was on the decrease, it is estimated that only about fifty percent of the females were producing young.

The following summary, for 1938 and 1939, of pregnant females emphasizes the greater number of young per litter in 1938 than in 1939.

No. of embryos	5	6	7	8	9	10	11	12	13	14	15
1938, no. females examined	1	3	3	10	20	23	16	15	5	1	1
1939, no. females examined	2	5	10	16	10	3	1	1			

The average number of embryos was ten (17 pregnant females) in 1937; ten (98 pregnant females) in 1938; and only eight (48 pregnant females) in 1939.

In the examination of hundreds of these female squirrels, only a few embryos were found dead. Although no definite figures were kept in this regard, my estimate, from memory alone, is one-half of one percent. It was noted also that an embryo seldom died after it was half developed. Most dead embryos were approximately four millimeters in diameter.

ACTIVITY OF YOUNG

The young, born naked and blind, live in the burrow with their mother until about two-thirds grown. The mother nurses them up to the time when, and sometime after, they are able to leave the burrow and forage for themselves. The young may be seen thrusting their heads out of the burrow about May 1. After several days of viewing the world from the entrance of the

burrow, they venture out, gradually increasing the distance they wander in search of food, until they are able to travel as much as a hundred feet and still find their way back home. Many of the young squirrels on their first few trips from the burrow get lost and start squeaking. General observations lead me to believe that many of these lost young find their way back to their burrows unaided. Although I have watched for it, I never have seen any response from a female to the squeaking cries of the young.

The young continue to suckle even after they have learned to eat green vegetation. This is shown by the following observation. On May 12, 1939, one mile north of Fallon, at 11:45 a.m., I saw, from a distance of fifty feet, a female squirrel standing erect supporting herself with her tail. This is the customary way for these squirrels to stand when watching or looking for an intruder. As she was standing thus, eight young squirrels were attempting to suckle her. Four of them appeared to be sucking on the four lowest teats while the other young attempted to nudge these four away. At 1 p.m. I placed carbon bisulphide in the main burrow and auxiliary burrow inhabited by this family. On excavating the burrows I found nine young, seven of which were females, dead in the main burrow. The stomach of each of them contained green vegetation.

The nest was made of fibers from under the bark of a cottonwood tree, felled approximately thirty feet away. These young squirrels appeared to be about the same size as other young squirrels then appearing above ground. The total combined weight of these nine juveniles was 11 ounces. The adult female weighed 5½ ounces.

By the middle of June, most of the young have either found an old burrow to occupy or have dug a new one. Only one young occupies a burrow. At this time they may be seen carrying dry grass and other loose material for a nest.

The males appear to take no part in caring for the young. They obtain sufficient food to become fat enough to go into aestivation by the last week in June. The females with young expend much energy in producing and suckling their offspring. Possibly it is this expenditure of energy that delays accumulation of fat by the females until after the young have been weaned. Evidence in support of this possibility is furnished by my examination of 52 squirrels in this month. The males, on the average, were fatter than the females, and large accumulations of fat were to be noted in the abdominal cavity of each male examined.

FAMILY AND INDIVIDUAL RELATIONS

Twenty-five inhabited burrows in all were excavated in the months of March and April. Each contained only one squirrel. In this period many squirrels were seen fighting. After the young had established themselves in individual burrows many of them, too, were seen fighting. On about a score

of occasions, especially in 1938, I found small squirrels, only a few days old, partly eaten and often still squirming, lying at the entrance of a burrow. Once I saw an adult, at the entrance of a burrow, eating one of two young squirrels. Then within a minute's time or less another adult appeared from fifty feet to the north and immediately attacked the adult that was eating the young. A battle ensued. A shot from my gun killed both contestants. The adult that was eating the two young squirrels was a male, the other a female. Perhaps the male had gone into the female's burrow while she was away and had stolen the young. On several other occasions I saw adult squirrels eating young. In each instance evidence pointed to an adult of their own kind as responsible for the killing. The young squirrels eaten were only a few days old; their eyes were not yet opened.

Although many of my field observations have shown these squirrels to be

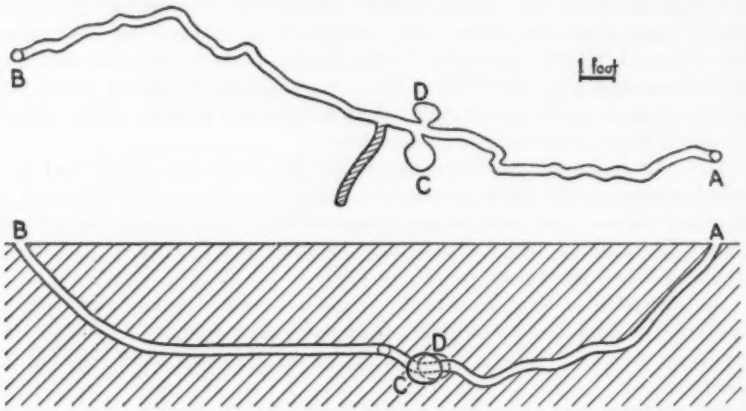

FIG. 1. Diagrammatic drawing of a main burrow excavated on May 19, 1939, one mile northwest of Soda Lake, Churchill County, Nevada. Upper drawing shows burrow as if viewed from above and lower drawing as if viewed from the side.
A and B. Entrances. C. New Nest. D. Old, decayed nest.

intolerant of others of their kind, the squirrels that I have kept in captivity appear to be sociable. Two males, three females, and one juvenile judged to be about twenty days old were all placed in a cage that was six feet long, four feet wide, and two feet deep, with one small box, one foot square, inside this cage for a nest. These squirrels, in captivity for six weeks, ate apples, rolled oats, meat, alfalfa and four or five kinds of weeds. All slept in the same nest in the box and I saw no intolerance toward one another.

SWIMMING AND CLIMBING

It is common knowledge among ranchers of the area about Fallon that these squirrels voluntarily swim across canals that are from ten to twenty feet wide.

In the past four years, I have seen scores of squirrels, both old and young, swimming across the canals in this locality. On May 19, 1936, I was sitting on the bank of a canal watching a squirrel on the opposite side. The canal was full of water but there was little current. The squirrel entered the water and swam the twenty feet toward me. Apparently he did not know I was there until I captured him as he started up the bank on which I sat. He was fairly fat and apparently in good condition.

To obtain food, nest material, or a better view, these squirrels often climb into the tops of bushes. I have seen many on fences made of wire netting, apparently attempting to see over the top of the grass. They are unable to climb a fence post that is set at right angles with the surface of the ground but they climb to the tops of posts that lean at an angle of forty-five degrees.

BURROWS

The following table gives some information about a number of burrows that were excavated on wild land.

Dimensions (in centimeters) of burrows of *Citellus townsendii mollis* excavated 4 to 8 mi. W of Fallon, Churchill Co., Nevada

DATE EXCAVATED	LENGTH OF BURROW	GREATEST DEPTH OF BURROW	DIAMETER OF BURROW	NUMBER OF OPENINGS	DEPTH BELOW GROUND OF NEST	DIAMETER OF NEST CHAMBER	KIND OF SOIL	NUMBER OF AUXILIARY BURROWS	
May 12, 1939	292	60.0	7.5	3	27.0	18.0	clay	1	Home burrows of adults.
May 1939	317	56.8	9.5	1	56.8	20.0	clay	1	
May 1939	700	83.0	10.0	2	80.5	19.0	sand	?	
May 18, 1939	1197	146.5	13.0	2	146.5	25.0	sand	3	
May 19, 1939	1742	117.0	15.0	3	103.0	20.2	sand	?	
May 19, 1939	642	117.0	10.0	2	92.6	19.4	sand	?	
May 12, 1939	72.5	30.6	7.0	1	No nest		clay	—	Auxiliary burrows at feeding places.
June 1939	78.6	45.0	10.0	1	"	"	clay	—	
June 1938	78.6	38.1	10.0	1	"	"	sand	—	
April 1937	92.7	40.3	8.0	1	"	"	sand	—	
June 1937	233.6	58.6	8.0	1	58.4	17.0	clay	none	Home burrows of young.
June 1938	262.8	72.5	7.0	1	72.5	18.5	clay	none	
June 1937	292.0	72.5	7.0	1	58.4	17.0	sand	none	
June 1939	448.8	78.6	7.0	1	72.5	20.0	sand	none	

Three classes of burrows may be recognized: The main burrow of the adults, the main burrow of the young, and the auxiliary burrows used by both adults and young. As may be seen from the table, the burrow of one adult may extend for more than 50 feet. Many are 5 feet deep and have more than one opening.

The auxiliary burrows are used only as places in which to hide and are usually dug close to good feeding grounds. Where the adult leaves the main burrow and goes more than 50 feet to forage, a well beaten path usually connects the opening of the main tunnel with that of the auxiliary tunnel. On leaving the main tunnel, the squirrel commonly goes directly to this auxiliary burrow, and there, after satisfying itself that all is well, begins to feed nearby. On being alarmed, the squirrel gives a shrill, short whistle as it runs to this burrow and sits up to see if danger has passed. Other squirrels in the vicinity on hearing the whistle of alarm run to their burrows. If a person approaches at this time, the squirrel may again give a short whistle denoting alarm and run into the auxiliary burrow. These burrows are seldom over 5 feet long. They have only one opening and no nest chamber.

A main burrow of a juvenile squirrel seldom has more than one opening and its depth and extent are much less than in an adult's burrow. Home burrows of juveniles may be distinguished from the auxiliary burrows in that they usually contain a nest.

In burrowing in sand near Fallon, the squirrels often encounter a hard stratum of clay from one-half to three or more inches in thickness at a depth of four or five feet. The major portion of the burrow often follows under this stratum of clay which prevents sand from caving into the burrow and nest chamber.

Burrows dug into canal banks and in cultivated fields usually have one opening and are much shorter than those dug on the desert in sandy soil. A burrow dug in a good location and not molested may be cleaned out and used year after year, with the addition of a new nest chamber.

During the time the female is suckling young, the tunnel within two or three feet of the nest chamber is often very dirty. Droppings and other waste materials collect in this vicinity, and many worms, insects, and larvae may be found in this unclean mixture. The insects included three kinds of histerid beetles and larvae of at least three kinds of flies (Diptera). On several occasions, in removing a new nest, decomposed young squirrels were found in the soil immediately underneath.

The nests themselves also contained many insects. Those identified were numerous adult flies (family Muscidae), fleas (Siphonaptera), and what appeared to be mites. In many burrows, cave crickets (order Orthoptera, subfamily Rhaphidophorinae) and ants (family Formicidae) were found.

The nests are made of whatever convenient material is closest to the burrow. On the desert where bunch grass (*Oryzopsis hymenoides*) is common, the nests were usually made of it. The bark of black sagebrush (*Artemisia tridentata*) was often used. Many bushes of this plant were completely cleaned of all loose bark from the ground up to as far as the squirrels could reach or climb. Juniper posts are used by ranchers in this district. When the loose bark has

not previously been removed from the posts, the squirrels often take it as far from the ground as they are able to reach.

FOOD

These squirrels subsist mainly on green vegetation, a predilection that explains their habit of concentrating around fields of alfalfa and growing grain. Here they burrow into the high ground near the supply of green food. They attack the crops at the edges of the fields. Around both alfalfa and grain fields, a marginal strip several hundred feet in width may be destroyed. Sprouting corn is also dug up and eaten. They are voracious eaters and their stomachs are kept full all day. The greatest amount of food is consumed in early morning when these animals are most active. These squirrels also eat members of their own species that are killed by automobiles, sometimes carrying the crushed body of one of these dead squirrels to a place of safety before feeding on it.

ENEMIES

The ground squirrels are preyed on most heavily in the period from May 15 to July 1. During this period the juvenile squirrels apparently have not learned to recognize their enemies; at this time I have seen prairie falcons, Swainson hawks, red-tailed hawks, and rough-legged hawks catch them with seeming ease. Eleven Swainson hawks collected in June of 1937 and 1938 had Piute squirrels in their crops. Seven red-tailed hawks that were collected in June 1937 also had Piute squirrels in their crops. On several occasions, when gopher snakes were killed, examination revealed juvenile squirrels in their stomachs. Once I saw a weasel carrying a squirrel across a road. In November, 1937, while attempting to dig out a badger, I came upon fresh remains of three squirrels in the burrow. I do not know how badgers are able to find squirrels that are in hibernation; but I judge from signs that they dig out and eat many in winter.

LOCAL MIGRATIONS

In an attempt to learn about local migrations, we exterminated all squirrels, as far as possible, on a cultivated field of 40 acres and on each side for one quarter of a mile back from the field. This field was surrounded by desert and there was no other ranch nearer than two miles. The animals were killed by placing strychnine-coated rolled oats in runways and at entrances to burrows. After several days, carbon bisulphide was placed in burrows that showed signs of having live occupants. No. 1½ Victor steel traps were set at some burrows.

I estimated that there were thirty squirrels to the acre on the area before poisoning operations began and that at the end of the period of ten days, in which extermination was carried on, there was one animal per acre. Squirrels

from the surrounding territory moved in on all the area and ten days after poisoning was discontinued I estimated eight squirrels to the acre. Fifteen days later (25 days after poisoning stopped), on July 15, 1939, I estimated 15 squirrels per acre. These observations show that at the season of greatest population-density, in a year when the species was only a little below the peak in numbers, some squirrels in a ten-day period travel a quarter of a mile or more.

California Museum of Vertebrate Zoology, University of California, Berkeley, California.

NOTES ON THE LIFE HISTORIES OF SOME UTAH MAMMALS

By W. S. Long

For almost a year, September 5, 1935 to August 10, 1936, I was engaged in field work in southwestern Utah. I spent the first five months with the U. S. National Park Service as Wildlife Technician in Zion and Bryce Canyon National Parks and Cedar Breaks National Monument. The rest of my time was devoted to private collecting of mammals, the bulk of which went to the American Museum of Natural History and the Cleveland Museum of Natural History. In this paper I wish to record my more pertinent observations on habitat, food, breeding, and in some cases, distribution. Acknowledgments are due to the following persons who have been of help in the preparation of this paper: Mr. George G. Goodwin, Mr. B. P. Bole, Jr., Mr. A. E. Borell, and Mr. Lawrence V. Compton. Mr. B. P. Bole, Jr., also identified many of the specimens collected.

LOCALITIES WORKED

1. Saint George, Washington County, Utah, elevation 2800 feet. February 15 to March 6, 1936. This locality is in the extreme southwestern part of the state, in the Virgin River valley. It is the only locality worked which lies entirely within the Lower Sonoran Zone. The river bottom here is intensively cultivated, but the surrounding country is desert, badly overgrazed by sheep and cattle.

2. Springdale, Washington County, Utah, elevation 3900 feet. January 25 to February 15; March 7 to March 15, 1936. This locality is about forty miles east of Saint George and is in the Virgin River valley at the lower end of Zion Canyon. It is on the border between the Upper and Lower Sonoran zones.

3. Zion National Park, Washington County, Utah, elevation 4000–7800 feet; Bryce Canyon National Park, Garfield County, Utah, elevation 6700–9000 feet; and Cedar Breaks National Monument, Iron County, Utah, eleva-

tion 10,500 feet. These localities were worked from September 5, 1935 to January 25, 1936. Zion National Park is in the pinyon-juniper belt, but extends into the lower edge of the ponderosa pine. It is an extremely rough, rocky region, characterized by deep canyons with vertical walls and by great talus slopes covered with boulders. The Virgin River flows through it from north to south. Bryce Canyon National Park is in an almost waterless region, although high enough to be typical of the ponderosa pine association. Cedar Breaks National Monument is characterized by spruce and fir forests, interspersed with open grassy meadows. There are no cultivated areas in any of these three localities.

4. Kanab, Kane County, Utah, elevation 5500 feet. March 17–30, 1936. The town of Kanab lies near the base of the south-facing Vermillion Cliffs. Here Kanab Creek cuts a deep canyon through the cliffs and furnishes water for many irrigated farms immediately south of the town. Beyond this irrigated area, the brush-covered desert stretches across northern Arizona to the Kaibab Plateau. To the north, the Vermillion Cliffs and the higher land above them are covered with the extensive pinyon-juniper forest that extends over much of southern Utah.

5. Panguitch, Garfield County, Utah, elevation 6600 feet. April 1–16, 1936. Panguitch lies in the Sevier River valley, which extends north for many miles through central Utah. It is a wide, fertile valley with many irrigated farms and is bordered on each side by high mountain ranges. Much of the valley is low and marshy; but there are also many areas of waste land which are too high to irrigate. The winters are so severe that field work here was hampered by periodic snow storms even in the first half of April.

6. Cedar City, Iron County, Utah, elevation 5800 feet, April 16 to July 15, 1936. To the east of Cedar City lie the Parowan Mountains which rise to a height of 11,315 feet at Brian Head Peak. To the west the desert, dotted with low pinyon and juniper-covered mountain ranges, stretches across Utah into Nevada. About an equal amount of collecting was done in the desert about Cedar City and at Woods' Ranch, 11 miles east of Cedar City. This ranch is at an elevation of 8100 feet and is just within the boundaries of the Dixie National Forest.

7. Beaver, Beaver County, Utah, elevation 5900 feet, July 17 to August 4, 1936. The country around Beaver is similar to that near Cedar City. The Beaver River, which flows from the mountains at this point, is bordered with a wide strip of large cottonwood trees which form a habitat not found in most of the localities worked.

8. Fillmore, Millard County, Utah, elevation 5700 feet, August 5 to 10, 1936. A large area of the mountain slopes and canyons east of Fillmore is covered with a dense stand of oak brush (*Quercus gambelii*), which is found less extensively farther south. All collecting was done in the town and in the foothills of the mountains.

LIST OF SPECIES

Sorex palustris navigator (Baird). Water shrew.—Water shrews are common on all of the streams flowing from the Parowan Mountains. They occur commonly only at the higher elevations, but at times they come down the streams into typical Lower Sonoran habitats, as shown by Presnall and Hall (Utah Acad. Sci., Arts and Letters, vol. 13, p. 211, 1936). In Zion National Park, tourists often reported "mice that swim under water" at the Emerald Pools, in Birch Creek Canyon. The identity of the "mice" was not established until Presnall took a water shrew there on October 27, 1935. Later (April 16, 1936) he caught one at Springdale, just south of the park, at an elevation of 3900 feet. On August 2 and 3, 1936, I took five specimens in a canyon 4 miles east of Beaver, at 6500 feet elevation.

These shrews are usually found along swift mountain streams, in piles of drift wood, and under overhanging banks and rocks. They do not readily take bait, but they can be usually caught by setting traps in their runways. Of 23 specimens taken, only 3 were caught in such a way as to indicate that they had been attracted by the bait.

In making the rounds of the trap-line at Beaver on August 3, 1936, I found a trapped shrew that had been swallowed by a garter snake (*Thamnophis ordinoides*). The snake was lying on a wet rock, holding on to the shrew which it had swallowed tail first as far as the trap would allow. When picked up, the snake disgorged the shrew, which was covered with slimy saliva. These snakes, which are found along the streams as high as 9000 feet or more, possibly are important enemies of the water shrews. No predator except snakes could follow them into the crevices in the rocks where they make their homes.

There are some indications that these shrews have more than one litter of young in a season. Three females taken at Cedar City on June 30 and July 4, 1936, had active mammae, while one taken at Beaver on August 2, 1936, was carrying five small embryos.

Eptesicus fuscus fuscus (Beauvois). Big brown bat.—Just at dusk on July 26, 1936, a number of these bats were seen flying from the eaves of one of the ruined barracks at old Fort Beaver, two miles east of Beaver. The projecting edges of the roof had been boarded up on both sides of the rafters, leaving a dark space inside. Here the bats had established a small colony. A few minutes later, free-tailed bats (*Tadarida mexicana*) began flying from the eaves, and the two species were still leaving the roost when darkness arrived.

Next morning when the roost was investigated, it was found that the big brown bats were in the peak of the eaves, while the free-tails were mostly by themselves lower down. Twelve adult female brown bats were taken, but there were no adult males in the colony. Most of the females had young which were at the stage where they were too small to fly but too large to be carried by the mother.

On July 28, a group of about 25 young and a few adults was found clinging to the chimney and hiding in cracks in the attic of this same building. The entire colony had moved from the eaves, where first seen, into the attic. Every adult bat examined was a female.

On August 6, another mixed colony of big brown and free-tailed bats was found in the attic of an occupied house on the outskirts of Fillmore. Although there was some mingling of the two species, most of the individuals were grouped separately. As was also the case with the other colony, all the big brown bats were either females or young. The young were half grown but still nursing; only a few were attached to the females; the rest were clinging to the chimney or the joists.

Corynorhinus rafinesquii pallescens (Miller). Pallid lump-nosed bat.—A small colony of this species was found at Fort Beaver on July 28, 1936, in the same ruined building which harbored a mixed colony of big brown and free-tailed bats. They were in the

main part of the attic, clinging to the roof in a cluster less than a foot in diameter. Because of the numerous holes in the roof, the attic was little darker than an ordinary room; no other species of bat was found in this light part of the building.

A sweep of an insect net took fifteen adult females, also a number of immatures that were large enough to fly. Only one small young was seen—a nearly naked one that was clinging to a nipple of one of the females.

Next day the roost was abandoned, with the exception of two individuals. In the basement, the first adult male was found. In the attic of another of the buildings, six of these bats were discovered and two males were collected. Apparently, the males prefer to hang up singly. These males were alert and hard to approach, turning their heads restlessly, and flying at the least noise. In marked contrast was an immature male found in the basement; it was cold and torpid and did not move until warmed in my hands. It was hanging against the side of a joist with ears folded. These bats often hang by only one foot.

Tadarida mexicana (Saussure). Mexican free-tailed bat.—This bat was found at Beaver and Fillmore, associated with the big brown bat (*Eptesicus fuscus fuscus*). Both sexes were present, but the females were in the majority (9 to 3, in twelve specimens taken at Beaver). On July 28, 1936, the day following the discovery of the bats at Beaver, the colony was completely deserted and there was no further trace of the bats at this locality. The breeding season of this species was apparently long past. No small young were found; only a few individuals were immature and, evidently, they were young of the year. The females showed no signs that they had been nursing young recently, and none of those skinned for specimens was pregnant.

Marmota flaviventris englehardti (Allen). Englehardt marmot.—Marmots, though sometimes seen in open fields in the stream bottoms, are usually found in the deep canyons and cliffs of the higher mountains. On March 30, 1936, one was found living in a metal culvert under the highway five miles north of Glendale, Kane County; another had a burrow under a piece of discarded machinery in a field near Alton. As a rule, 7000 feet is the lower limit of range in this region. A few marmots occur in Zion National Park between 5000 and 6000 feet, and one family of young has been raised in Zion Canyon each year for several years. This den is in the talus slope at the base of vertical cliffs at an elevation of about 4500 feet.

The first young were seen on June 21, 1936, eleven miles east of Cedar City; they were at least one-third grown and probably had been out of the nest for some time.

Citellus variegatus utah (Merriam). Utah rock squirrel.—In the lower country the rock squirrels take the place of the marmots. They are common throughout the desert canyon country up to about 7000 feet, and are rarely seen above that elevation. They are especially abundant in the boulder-strewn talus slopes at the base of the canyon walls, where their burrows lead down between and under huge boulders. Here they are relatively safe from all predators except weasels and snakes.

Hibernation is intermittent and of short duration in the extreme southern part of the state. In Zion National Park most of the rock squirrels disappeared in October or early November; but they were to be seen on warm sunny days throughout the winter. Individuals were seen in the park and at Springdale on November 7, November 26, and December 25, 1935. No more were noticed until the first days of March, when they were fairly common. At Saint George, 1000 feet lower in elevation, they were commonly seen throughout the last half of February, 1936, in the fields and rocky places along the Virgin River. Above 5000 feet, they did not appear until about April 1.

No pregnant females were recorded, but on June 28, 1936, a female followed by a single young about the size of an antelope ground squirrel was seen near Cedar City. Young were commonly seen from that time on; by July 15 they were half grown.

They often climb into low bushes and trees, and even on buildings, to obtain food

or higher observation points. I have seen them gathering seeds of saltbush (*Atriplex canescens*), juniper (*Juniperus*), and box elder (*Acer negundo*). On August 8, 1936, a male shot at Fillmore was carrying six acorns of the Gambel oak in his cheeks.

Citellus lateralis lateralis (Say). Say ground squirrel.—The forested part of the mountains above 7000 feet elevation is the natural home of the Say ground squirrels. They are partial to clearings in the forests and are often common about ranch buildings. They were abundant in the open meadows of Bryce Canyon National Park and Cedar Breaks National Monument, and they occurred in the slide rock on Brian Head Peak, 11,300 feet, in association with pikas (*Ochotona princeps fuscipes*).

Hibernation is rather late. Individuals were seen on Brian Head Peak on September 30, 1935 and at Bryce Canyon National Park (about 8000 feet) on October 9, 1935. At the lower elevations, they emerged from hibernation about the first week of April; little is known of the date of emergence at higher elevations where the ground is commonly covered with snow until June or July. There are usually six or seven young. Of four females collected on May 20, 1936, 11 miles east of Cedar City, two carried 6 embryos and two carried 7, varying from 5 to 27 mm. in length. Young were seen for the first time on July 4, 1936 at this locality.

Citellus townsendii mollis (Kennicott). Piute ground squirrel.—Unbelievable numbers of these ground squirrels were found in the desert west of Cedar City. The ground under the brush was honeycombed with their holes, as were the ditch banks and railroad embankments. Where the brush had been destroyed by grazing sheep, the squirrels dug their holes in the open with no protection whatever.

By May 2, 1936, hundreds of young were seen in the brush. They were about the size of sagebrush chipmunks (*Eutamias minimus consobrinus*). Some idea of their abundance may be gathered from the fact that on two different occasions on the same day, two young were caught simultaneously in one rat trap. It was almost impossible to catch the adults without first cleaning out the young.

By the middle of July, most of them were in hibernation; the last individual was seen on July 25, 1936, near Adamsville, 9 miles west of Beaver.

Citellus leucurus subsp. Antelope ground squirrel.—In the lower deserts these little ground squirrels occurred abundantly in the Lower Sonoran Zone, but sparingly in the Upper Sonoran. At Saint George, they were found by the thousands. Traps placed almost anywhere would catch them. Here they were taken in wood rat houses, in kangaroo rat mounds, and in rocky cliffs, but at higher elevations, they were found only in the rocky cliffs and talus slopes.

A female caught at Saint George on February 29, 1936 carried 6 embryos, and one taken at Kanab on March 23, 1936 had active mammae. Many young about the size of mice were seen in the lower end of Zion Canyon on June 23, 1936. These probably represented second litters.

At Saint George many individuals were infected with a disease which caused open sores and permanent scars. At first, these sores were thought to be caused by bot flies, but no larvae were found in any specimens. On February 21, 1936, all of 14 specimens taken showed signs of the disease. Some had only a few old scars on the feet, while others had three or four large open sores on the back, sides or legs. The severe infections caused the loss of large patches of hair, as much as one inch in diameter. In active cases, the skin sloughed off when touched. The disease did not seem to bother the animals greatly, as a large percentage of those infected had entirely recovered; and the infected ones seemed to be as lively and active as the others. No dead individuals were found in the field. It was necessary to move the traps to a different locality about a mile away to get healthy animals for specimens.

Observations suggest that these ground squirrels at times live almost exclusively on

the seeds of the saltbush (*Atriplex canescens*); but at Saint George, their cheeks usually contained mesquite beans.

Apparently they do not hibernate in the southern part of their range, as they were active all winter at Springdale and at Saint George.

Cynomys parvidens Allen. Utah prairie dog.—Prairie dogs were common in several places throughout the region. Their habits differ from those of the plains species (*C. ludovicianus*) in that the animals prefer to live in brushy areas rather than in open grassland.

Two females taken in the desert west of Cedar City on May 3 and 4, 1936 had active mammae. In this dog town on June 27 there were many young ranging in size from those similar in size to a Say ground squirrel to those that were half-grown.

Eutamias quadrivittatus inyoensis Merriam. Inyo chipmunk.—These chipmunks are common in the canyons and mountains as high as 11,000 feet. At Cedar Breaks National Monument they were seen as late as November 1, 1935. Tracks were seen in the snow still later.

Eutamias dorsalis utahensis Merriam. Utah cliff chipmunk.—Inhabiting the pinyon-juniper belt, mostly between 5000 and 6000 feet, these are the shyest of all the Utah chipmunks. Usually the first indication one has of their presence is a series of sharp "chips" and a glimpse of a gray streak heading for a hole in the rocks. They are not as curious as *E. quadrivittatus* but squeaking will sometimes bring them within shooting distance.

They are confined almost exclusively to rocky places around cliffs and talus slopes. A female taken eight miles west of Cedar City on May 12, 1936, had active mammae. A full-grown young of the year was taken near Cedar City on July 15, 1936.

Eutamias minimus consobrinus (Allen). Wasatch chipmunk.—The smallest of southern Utah chipmunks, this species is usually seen in the open sagebrush deserts, rather than in forests or on rocky cliffs, but sometimes it is found a considerable distance up the canyons. At Cedar City and Beaver, the animals were common in the sagebrush and rabbitbrush, but were shy and hard to approach. When alarmed they ran swiftly over the ground with the tail held stiffly out at a 45 degree angle from the body. Young were out early in July.

Tamiasciurus fremonti fremonti (Audubon and Bachman). Fremont chickaree.—The only tree squirrel encountered was the chickaree, common throughout the fir and spruce belt. Apparently it does not occur in other kinds of trees. Each clump of conifers harbors a squirrel or two, even in areas where the firs and spruces occur only in scattered clumps among the aspens. No chickarees are found in the stands of pure aspen.

These squirrels are so tame that they may be closely approached. In the fall, they are noisy and conspicuous, running up and down the trees and barking furiously at an intruder. During the breeding season, however, they are quiet and subdued; the usual note then is the long rattling call.

The nests are made of moss and shredded bark on a foundation of small twigs and they are usually placed away from the trunk, well out on the limbs of the trees, sometimes almost at the tips of the branches. They may be at almost any height, from eight feet to the top of the tree. There are indications that dummy nests are often constructed. Sometimes there will be as many as five or six nests in a clump of trees where the most diligent hunting discloses only one or two squirrels.

A female collected at 8000 feet, 11 miles east of Cedar City, on May 17, 1936, was carrying three embryos which measured 32 millimeters in length. Another taken in the same place on July 5, 1936 was nursing young.

The food consists almost entirely of spruce and fir seeds. The feeding place is usually

a clump of trees or a fallen log, where a huge pile of cone scales collects. One such pile was twenty feet in diameter and at least two feet deep. When the squirrels gather cones in the fall, they cache them in these piles of scales. The distribution and abundance of these squirrels probably is dependent on the cone crop; when this fails, the chickarees disappear from large areas of the forest.

Thomomys bottae planirostris Burt. Zion Park pocket gopher.—This gopher was common in the parts of Zion National Park where the soil was loose enough for easy digging. On November 21, 1935, C. C. Presnall and I excavated a burrow in Coalpits Wash, near the west side of the park. The entrance to the burrow, under a clump of rabbit brush, was open when it was discovered. Many small storage chambers dug in the sides of the main tunnel were packed with the fresh green leaves of *Pentstemon*. Seventy-five feet of this tunnel were examined before it turned abruptly downward and became too deep for further digging.

At Springdale, 15 specimens were taken in one small patch of alfalfa early in February. The gophers were cleaned out of this small area as well as possible, yet a month later they had reoccupied the patch. At this time several more were taken, of which all but two were half-grown young. Where small patches of alfalfa are surrounded by large tracts of wild land, it is hopeless to try to exterminate the gophers by infrequent trapping or application of poison.

Thomomys talpoides parowanensis Goldman. Parowan Mountains pocket gopher.—These dark-colored gophers were found throughout the mountains at elevations from 7000 to 11,000 feet. Open meadows and clearings about ranch buildings were the most favored habitats. The animals were uncommon in the forested areas. During the winter, when the snow is deep, they move large quantities of soil to the top of the ground and pack it into the tunnels in the snow. When the snow melts, this soil is left in rope-like piles on the surface. Extensive areas may thus be covered. However, a few hard summer rains wash the soil away so that it does not interfere greatly with the growth of the grass. Indeed, the gopher performs a service by bringing subsoil to the surface to be mixed with vegetation, and by making holes which allow faster penetration of water, thus decreasing destructive runoff.

Perognathus formosus Merriam. Long-tailed pocket mouse.—Only one species of pocket mouse was found and this only at Saint George and Springdale. Eight specimens were taken from among the boulders and rocks of the talus slopes in deep canyons.

Dipodomys microps subsp. Kangaroo rat.—This animal was abundant in the desert two miles south of Beaver. The soil was sandy, but rather more compact than the soil usually preferred by kangaroo rats. The burrows were scattered about through the brush instead of being clustered into close mounds.

Of three females taken on July 21, 1936, one showed no sign of breeding, but each of the others carried four embryos the size of peas.

Dipodomys merriami frenatus Bole. Bole kangaroo rat.—At Saint George, these little kangaroo rats were abundant in sandy places along the Virgin River. Most of their burrows were at the base of clumps of *Tamariz* where the wind had blown the sand into hummocks. Twenty-one rat traps set here took ten rats in one night. They were common also on the mesa north of town where the soil was hard and stony, and where the only vegetation was creosote bush.

Dipodomys ordii cupidineus Goldman. Kaibab kangaroo rat.—At Kanab these rats were common on all of the lowlands east of the town, and also along Kanab Creek to the north. They were especially abundant in dense growths of Russian thistle in the gullies along the creek. This weed furnished one of the staple foods of most of the desert rodents; kangaroo rats seemed to prefer its seeds to all other kinds. Wherever a windrow of thistles had piled along a fence, the rats usually were present. One specimen was taken in Bryce Canyon National Park on October 11, 1935. Several specimens

were torn to pieces in the traps, presumably by grasshopper mice. Four females taken on March 21, 22, 28, and 29, 1936, at Kanab, all had active mammae.

Castor canadensis subsp. Beaver.—Beaver seemed to be common on the Sevier River and its tributaries, the only places where fresh beaver signs were seen. There were no dams or houses; but in the neighborhood of Panguitch, several dens were found under the roots of trees or around log jams. Many peeled sticks were floating in the water or lodged against the bank. In some places along the bank, so many cottonwood trees had been felled that it was almost impossible to get through the tangle. In a few places, small dams had been thrown across irrigation ditches. One beaver was seen on the bank of the river near Panguitch just at dusk during the first week of April.

Onychomys leucogaster melanophrys Merriam. Grasshopper mouse.—At Kanab, these mice annoyed the collector by tearing up many trapped kangaroo rats and white-footed mice. The four specimens taken there were caught in traps set for other mammals. Two females taken March 22 and 29, 1936 had active mammae.

Onychomys torridus longicaudus (Merriam). Grasshopper mouse.—Grasshopper mice at Saint George were taken at the burrows of antelope ground squirrels and kangaroo rats, and in woodrat houses. One was taken in a burrow about four inches in diameter. The specimens of other small mammals that were eaten after being trapped were presumably destroyed by these mice. A female taken February 27, 1936 carried four embryos measuring 21 mm. in length.

Reithrodontomys megalotis megalotis (Baird). Desert harvest mouse.—Harvest mice were abundant in all suitable localities below 5000 feet elevation, but were not common higher than that. The favored habitats were in the vicinity of water—marshes, irrigation ditches, or creeks. The mice were, however, sometimes taken far from water on the driest desert. Long grasses or cattails were the preferred cover; but the mice were often taken in ditches or along fences in windrows of Russian thistle.

At least two litters of young are produced, as the following records show: Springdale, March 15, 1936, 3 small embryos; Kanab, March 19, 1936, 4 large embryos; Beaver, July 24, 1936, 4 small embryos.

Peromyscus maniculatus sonoriensis (LeConte). Sonoran white-footed mouse.—These mice were the most characteristic and abundant of the small mammals of southwestern Utah. They were taken at every locality where any trapping was done, and apparently they occupied all habitats, although they were more common in some than in others. They were found in the desert, among the sagebrush, cactus, and mesquite; in deciduous timber along the streams; in the rocky walls of deep canyons; and in the coniferous forests. Many were taken in traps set for water shrews along swift mountain streams. Traps set in the tule marshes usually took a few specimens.

These mice were most abundant between 5000 and 6000 feet elevation, but they were found everywhere between 2700 and 8300 feet. No traps were set higher than this. They were almost unbelievably abundant in some localities; at Kanab a long trap line set in almost any habitat would take a mouse in nearly every trap. Fences piled high with Russian thistle were found to be favorite resorts. Large catches were made in this type of habitat. The mice were least common in deciduous timber. On April 2, 1936, 40 traps set in brush heaps and around fallen logs in cottonwood timber along the Sevier River at Panguitch took only three individuals.

Apparently the breeding season of this species extends throughout the year. Young in the blue pelage were taken at every locality except Panguitch. The following records give some indication of the season and size of litters: Kanab, March 18, 1936, 5 small embryos; March 19, 1936, 4 and 6 embryos; March 21, 1936, 4 and 6 embryos; March 22, 1936, 5 small embryos; March 29, 1936, recently nursing young; Panguitch, April 2, 1936, 5 large embryos; Cedar City, May 4, 1936, active mammae and 5 large embryos; May 7, 1936, 4 large embryos

Peromyscus boylii rowleyi (Allen). Rowley white-footed mouse.—These mice are found in oak chaparral in the Upper Sonoran Zone. In Zion National Park they were taken in oak brush between 4000 and 6000 feet, in association with *P. maniculatus sonoriensis*. Of four females taken at Springdale, March 14, 1936, two carried three and two carried four embryos.

Peromyscus truei truei (Shufeldt). True white-footed mouse.—These are real rock mice, as they are almost invariably found among the boulders on the talus slopes at the foot of vertical cliffs or in crevices and holes in the cliffs themselves. In this region, they reach their greatest abundance in the pinyon-juniper belt, between 4000 and 5000 feet, but Presnall has taken specimens in Bryce Canyon National Park slightly above 7000 feet.

The following breeding records were obtained: Springdale, March 15, 1936, 3 embryos; Kanab, (2 specimens) March 29, 1936, mammae recently active; Cedar City, May 19, 1936, 3 embryos.

Peromyscus crinitus subsp. Canyon mouse.—Canyon mice were found in the rough, rocky canyon walls, talus slopes, and at Saint George in stony ground, on the top of a high mesa. They are typical of the Sonoran zones and were taken as far north as Cedar City. At Cedar City a female with active mammae was taken on May 19, 1936, and a full grown young of the year on July 15.

Peromyscus eremicus eremicus (Baird). Desert white-footed mouse.—These mice were found only at Saint George, in the Lower Sonoran Zone. They were abundant in the rich loamy soils of the river bottom, but were not taken in rocky places.

Neotoma lepida subsp. Thomas woodrat.—Woodrats were abundant in every locality except Panguitch and Cedar City. Only a few were taken at the latter place, and none at the former. In the open deserts, they build conspicuous houses in the creosote bush and cactus, and about the bases of mesquites. In the rocky canyons they live among the boulders with the rock squirrels. Their presence is betrayed by sticks and other trash piled under the rocks. At Kanab several were taken in a gully filled with dried Russian thistles. The rats had made a network of trails through the thistles and along the banks of the gully; but there were no signs of any houses.

The breeding season extends over much of the year, as the following records indicate: Saint George, February 29, 1936, 3 large embryos; Kanab, March 20, 1936, 3 small embryos; March 28, 1936, 3 large embryos; March 30, 1936 (2 specimens) 3 large embryos each; Cedar City, May 12, 1936, 2 small embryos; Beaver, July 22, 1936, 3 large embryos.

Neotoma cinerea cinerea (Ord). Bushy-tailed woodrat.—Bushy-tailed rats were fairly common at the higher elevations. The caretaker of the lodge at Cedar Breaks National Monument said they were a nuisance there, but our traps were undisturbed during two nights. Presnall has taken specimens at Bryce Canyon National Park. A female taken under a ruined mill near Panguitch on April 4, 1936, was not breeding.

Microtus mordax mordax (Merriam). Long-tailed meadow mouse.—This species was taken only on swift mountain streams in the same habitat as the water shrews (*Sorex palustris navigator*). Rocks and driftwood formed the favorite cover; a trap set in such places often took either a meadow mouse or a water shrew. A female trapped 11 miles east of Cedar City on July 1, 1936, was carrying 7 embryos, measuring 21-24 mm. in length.

Microtus montanus subsp. Meadow mouse.—Meadow mice were common in marshy places at Cedar Breaks National Monument. They do not make as well-defined runways as do the eastern species and are not so conspicuous or so easily found as some other small mammals. Many old unused nests were found in tall grass and weeds at Spruce Lake, near the north side of the Monument. A series of meadow mice was taken at the marshes in the Sevier River valley north of Panguitch. At this locality the mice lived

along the irrigation ditches, where they made well-defined runways and burrows. They were not found at other localities.

Erethizon epixanthum epixanthum Brandt. Yellow-haired porcupine.—Porcupines were common in the National Parks, and on forested private lands, but were rarely seen in the National Forests, where active porcupine control was carried on. In the pinyon-juniper belt, the gnawing activities of these animals were conspicuous, probably because of the scattered stand of trees and the open nature of the foliage and branches; but the porcupines themselves were rarely seen. They became more common at the higher elevations, the peak of abundance being reached at Cedar Breaks National Monument, where it was not unusual to see six or more in a few minutes of driving in the evening. In spite of their abundance, I could not see that they were doing any important damage to the forest. Many trees had small patches of bark removed from the limbs and the upper part of the trunks; but there was little evidence that trees were dying as a result of this treatment. The porcupines spent a great deal of time in the open meadows grazing on grasses and other herbaceous plants.

Breeding occurs in the fall. On October 23, 1935, at Cedar Breaks National Monument, two porcupines were seen in a small tree in a clump of Engelmann spruce. The male continually pressed his advances upon the female but each time he approached she moved higher in the tree, only to be followed closely in a few minutes. An hour later, at dusk, the situation was unchanged, and the following morning the two were gone. On August 8, 1936, a half-grown young one was seen in a cottonwood tree three miles east of Fillmore.

These animals have few natural enemies, but Keller (Jour. Mamm., vol. 16, p. 232, 1935) reported evidence that coyotes had killed and eaten porcupines at Cedar Breaks National Monument.

Ochotona princeps fuscipes Howell. Parowan Mountains pika.—Pikas are found in slide rock in several places in this region, but their distribution is local and spotty. Many places which appear to be well suited for them are uninhabited, while others which have only small areas of slide rock are well populated.

On October 3, 1935, when C. C. Presnall and I went to the type locality on Brian Head Peak, the pikas were rather inactive. Although frequently heard, most of them were deep down in the rock slide. Only two specimens were collected during a half-day of hunting. Brian Head Peak attains an elevation of 11,315 feet.

This colony was visited again on June 14, 1936, and a pair of pikas taken. They were more active than before, but were shy and hard to approach. The female carried three embryos, which measured 38, 41 and 42 mm. in length (curled position, not total length).

Although a considerable area was covered with suitable rock, this colony did not seem to be in a flourishing condition. The animals were not so common as in other places with a smaller area of slide rock. In this area, pikas were also found in tumbled masses of lava 1500 feet lower in altitude.

Ochotona princeps cinnamomea (Allen). Beaver Mountains pika.—On July 30, 1936, a colony of pikas was found in Beaver Canyon, Beaver County, where masses of rock had fallen from the vertical cliffs and had slid down among the aspens on the talus slopes. Although the area was smaller than the one on Brian Head, the pikas appeared to be about as common as at that locality. The elevation was about 9500 feet.

Lepus californicus deserticola (Mearns). Colorado Desert jack rabbit.—Jack rabbits were seen at every locality below 7000 feet elevation. Most of those skinned were infested with bot-fly larvae, some of them with a dozen or more under the skin of the back. Those taken at Kanab were also covered with ticks, some of the rabbits being infested with hundreds of them. The ears were the parts most often attacked.

At Panguitch a jack rabbit, which possibly was suffering from the last stages of tularemia, refused to move when approached. It was killed with a short stick.

Two litters of young may be produced each year. On April 16, 1936, a female taken at Panguitch carried four young which would have been born in a few hours. They averaged about five inches in length. On May 5, 1936, at Cedar City, a female with six large embryos was taken. By June 27 half-grown young were seen in the desert west of Cedar City, and on July 15, a nursing female was shot in this same locality.

Young jack rabbits sometimes take refuge in holes instead of trusting to their speed to carry them to safety. On one occasion, a young one about the size of a cottontail ran into a prairie dog hole, ran out again, then ducked back as it saw me standing near by. This habit may account for the fact that extremely small jack rabbits are seldom seen, even in areas where adults are abundant.

Sylvilagus nuttalli grangeri (Allen). Black Hills cottontail.—These rabbits were common throughout the region, especially in river bottoms where long grasses and brush furnished them good cover. Two females taken at Panguitch on April 15, 1936, were already nursing young, although the weather was cold, and intermittent snow falls had been frequent during the previous two weeks.

Odocoileus hemionus macrotis (Say). Rocky Mountain mule deer.—Deer were abundant in the Dixie and Fishlake National Forests, and in the pinyon-juniper forests outside of the forest boundaries. They were not often seen at lower elevations unless driven down by deep snows or by hunters.

A deficiency of winter range here causes a serious deer problem, as it does in most of the western states. The natural winter range of the deer is in the valleys and foothills on land which is either irrigated farm land or public domain. The latter has been so badly abused that there is little forage left, either for deer or for livestock. In spite of the heavy hunting and a high winter mortality, the deer are increasing rapidly and there is much bitter feeling against them on the part of the local farmers and stockmen.

In Zion National Park, where the deer are not disturbed by hunters and are therefore easily observed, studies made during the fall and winter of 1935-36 revealed a number of interesting habits. Most of the deer are found in the higher parts of the park in the summer. After the first heavy snowfall on the plateau, the number of does and fawns increases rapidly in the canyon, but the bucks do not appear until the middle of November, when the rutting season starts. The rut lasts about one month, after which the bucks become more wary and are not often seen in the canyon. Most of them retire to secluded side canyons and rocky talus slopes where they remain during the winter.

Most of the deer spend the days on the talus slopes, bedding down under the live oaks (*Quercus turbinella*) and wild grape. Feeding starts about one or one and one-half hours before sunset, and at this time the deer can be seen crossing the highway as they move down from the talus slopes to the feeding grounds on the floor of the canyon.

During the rut, the population is shifting and unstable, but after January 1, individuals do not move about very much in the canyon and may be seen night after night in the same place. Fawns are inclined to stay with their mothers through the first winter, although the relationship is a loose one. In a few cases small spike bucks have been seen apparently following their mothers.

The concentration of deer in Zion Canyon has caused a serious problem of overgrazing. Willows and wild grapes especially have suffered from the feeding of deer, and it has been necessary to trap and remove a large number of these animals.

Biology Division, U. S. Soil Conservation Service, Salt Lake City, Utah.

NOTES ON THE LIFE HISTORIES OF NEW ENGLAND CAVE BATS

By Donald R. Griffin

The general habits of the bats found in New England have already been well summarized by Seton (1909) and G. M. Allen (1939) and also in several papers on the mammals of particular regions (Poole, 1932; Goodwin, 1935). Data are presented here on the distribution, hibernation, times of activity, and social habits of the cave bats found in New England. Most of this information was obtained incidentally during the years 1932–39, while I was banding cave bats to study their migrations. The evidence obtained on that subject has already been published (Griffin, 1936, 1940).

Part of this work was done during the summer of 1939, when I was a research fellow at the E. N. Huyck Preserve at Rensselaerville, New York. It is a pleasure to acknowledge the assistance and cooperation of the officers of the preserve and the residents of Rensselaerville. I wish also to acknowledge the courtesy of numerous owners of caves and buildings that contained bats, for they have invariably allowed me full and free access to their property. Finally I owe a special debt of gratitude to Dr. G. M. Allen for his frequent encouragement, constructive criticism, and friendly advice.

Six species of cave bats have been recorded from New England, and Table 1 shows the maximum numbers of each that I have taken at any one time in 10 typical bat caves. It is interesting to note that *Myotis keenii septentrionalis* and *Pipistrellus subflavus subflavus* are most abundant in the southern part of the area.

Table 1.—Numbers of bats hibernating in caves

State	County	Town	*Myotis lucifugus*	*Myotis sodalis*	*Myotis keenii*	*Myotis subulatus*	*Pipistrellus subflavus*	*Eptesicus fuscus*
Vermont	Orange	Vershire	132	13	66	8	3	68
Vermont	Rutland	Chittenden	136	241	2	1	5	—
Vermont	Windsor	Plymouth	31	73	21	2	2	—
Vermont	Bennington	E. Dorset	693	232	8	—	12	—
Massachusetts	Hampden	Chester	792	60	304	—	31	—
Connecticut	Litchfield	Roxbury	413	224	123	1	41	10
New York	Columbia	Ancram	301	5	49	—	25	—
New York	Albany	Altamont	213	8	7	—	10	—
New York	Albany	S. Bethlehem	99	—	—	—	4	4
New York	Albany	Clarksville	188	—	9	—	25	2

I have never observed in New England caves any consistent segregation of sexes into different groups. Nor is there any segregation of the various species. *Myotis lucifugus, M. sodalis* and *M. keenii* may all be represented in the same cluster, although the last species is more often found alone in

some small crevice. *Pipistrellus* and *Eptesicus* do not regularly associate very intimately with any of the *Myotis*, but hang singly or in clusters with others of their own kind. In a mine at Vershire, Vermont, groups of 15 to 25 *Eptesicus* were crowded into narrow crevices in the rock. All were in deep torpor, and were so tightly wedged into the crevice that many could not be extracted even with the aid of forceps.

Most bats seem to leave the caves in April or May, and New England bat caves are always empty during the summer in contrast to those in Indiana or Missouri, for instance, where some bats may be present at all seasons (Hahn, 1908; Guthrie, 1933). During the summer, *Myotis lucifugus* and *Eptesicus fuscus* frequently roost in buildings. Their favorite retreats are the spaces inside hollow trim at the end of the roof of an ordinary frame dwelling, although they are often found in other situations. Elsewhere (1940) I have described methods for catching them as they leave these roosts in the evening. I have not taken the other cave bats in houses or barns except occasionally behind blinds, although A. A. Allen (1921) has described colonies of *Pipistrellus* in buildings.

BREEDING HABITS

Only on one occasion have I observed copulation of cave bats. On November 13, 1937 at a cave near Altamont, New York two *Myotis lucifugus* were captured *in coitu* although most of the bats in the cave were hibernating.

In summer both *Myotis lucifugus* and *Eptesicus fuscus* form breeding colonies in buildings. Eisentraut (1934, 1936, 1937) calls such colonies *Wochenstuben* (= maternity wards), for they consist almost exclusively of adult females and their young. On rare occasions an adult male may be taken, usually very early or very late in the summer. There are also a few nonbreeding adult females in most large breeding colonies of little brown bats.

Eptesicus fuscus seems always to have two young each year, and *Myotis lucifugus* one. There is considerable variation in the date of birth of the latter species, for I have taken newborn young from June 13 to July 14. Does this variation of nearly a month indicate, as Eisentraut (1936b) suggests, that the bats that bear their young late are the ones that remained longest in hibernation? Or are they young females whose reproductive processes are slow? Hartman (1933) and others have assembled evidence to show that young females may not be inseminated until spring, while older females carry sperm in their uteri throughout the winter. Perhaps these older females begin their period of gestation sooner, and hence give birth to young in June, while young females must wait for spring insemination, which may occur so late that the young are not born until the middle of July.

For the first three or four days after birth the young *Myotis lucifugus* are usually carried by the mother as she hunts. But after that they seem to be

left in the roost, for many can always be seen or heard after all adults have left for the night's hunting. This, I believe, explains why only a small fraction of the bats caught in nets as they emerge from the breeding colony are carrying nursing young. On July 4, 1939 only 10 percent of the *Myotis lucifugus* at a breeding colony in Rensselaerville, New York returned to their roost before 4.45 a.m. From 4.45 until 5.00 a.m. 50 or 60 tried to enter a small crack in the building and the result was a confused accumulation of fluttering bats all hovering within five feet of the opening. Each individual made 15 or 20 vain attempts to alight at the precise opening before it succeeded. Sherman (1929) observed that *M. lucifugus* and *Eptesicus* seldom returned to their roosts before morning, except in September and October.

Although Eisentraut (1936b) found that *Myotis myotis* recognize their own young, Casteret (1938, 1939) reported that females of this species nurse their young indiscriminately, any female feeding any young regardless of blood relationship. I have been unable to determine whether this is also true of any American bats, but the first observer who has the opportunity should study this point.

Apparently *Myotis lucifugus* learns to fly when three weeks to a month old, for in early July the first immature bats are caught on the wing, and by August first most of the young are flying regularly. After this date the population of the breeding colonies declines rapidly. By mid-August adult females are scarce, and the bats remaining in the breeding colonies are mostly young.

When not congregating in large colonies the various cave bats must spend the daytime scattered in trees or behind blinds like those that Sherman (1929) observed so extensively. I have often found *Myotis lucifugus* in such situations during the summer, but I have not sufficient records for the other species to warrant definite conclusions.

I have frequently observed that during the summer *Myotis lucifugus* may relapse into what Eisentraut (1934, 1937) has called *tageschlaflethargie* (= day-sleep-lethargy). This is a sort of quasi-hibernation, such as Hahn (1908) observed, in which the temperature of the bat falls to that of the air surrounding it. As Eisentraut suggests, this drop in temperature and metabolic rate must be very useful during cold or rainy periods when insect food is scarce. Murphy and Nichols (1913) have reported a similar phenomenon in the hoary bat. This fact is interesting since the hoary bat does not normally hibernate. Eisentraut (1938) has also shown that even tropical bats have poor temperature regulation.

At the summer colonies of *Myotis lucifugus* that I have studied the bats were first seen May 11 to May 20 during various seasons. Sherman (1929) records first appearances of this species in Iowa as May 2 to May 30 and last dates as September 19 to October 16. F. L. Osgood (personal communication) has noted that near Rutland, Vermont, *Myotis lucifugus* first appears

regularly from May 19 to May 23, although occasional stragglers may be seen as early as March or April. My latest records for this species in summer colonies are:

Sept. 20, 1936, Hubbardton, Vermont: 3 in colony normally containing over 400 in mid-summer.
Sept. 7, 1932, Hatchville, Massachusetts: 1 in colony of more than 50 in mid-summer.
Sept. 5, 1934, Mashpee, Massachusetts: 3 in colony of 200–300 in July.
Sept. 26, 1937, Cotuit, Massachusetts: 1 in colony of 75–100 in mid-summer.

The earliest dates on which I have seen bats in New England caves are:

Oct. 9, 1937, North Adams, Massachusetts: 4 *Myotis lucifugus* and 3 *Myotis keenii septentrionalis*.
Oct. 11, 1936, Lanesboro, Massachusetts: 4 *Pipistrellus*
New Ashford, Massachusetts: 1 *Pipistrellus* and 1 *Myotis lucifugus*.
Oct. 12, 1938, Chittenden, Vermont: 9 *M. lucifugus*, 9 *M. sodalis*, 1 *M. keenii septentrionalis* and 2 *Pipistrellus* in cave containing 200–300 in winter.
Oct. 12, 1939, Plymouth Union, Vermont: 31 *M. lucifugus*, 28 *M. sodalis*, 3 *Pipistrellus* in cave containing 50–90 in mid-winter.

The cave listed above at Chittenden is Nickwacket Cave, where bats have frequently been collected. Specimens taken there have been labeled "Brandon," "Proctor" and "Pittsford," Vermont. The cave is actually in Chittenden, although best approached through Pittsford.

During the summer of 1939 I found that by mid-August many *Myotis lucifugus* had entered caves in Albany and Schoharie counties, New York, and all were hibernating soundly. This is almost two months earlier than I had ever observed them in New England caves. In two caves all these early arrivals were males and in one case they were very fat (average weight of 7 males, 11.3 grams, compared to 6 or 7 grams in June). At another cave, however, the sex ratio on August 26 was approximately 1:1, and the bats were not extremely fat; but two weeks later there were 124 males in this cave and only 3 females. Guthrie (1933) has reported that male *Eptesicus* appeared in Missouri caves earlier than the females, and Mohr (1932) has observed a preponderance of male *M. lucifugus* in August and September in Pennsylvania caves.

STABILITY OF GROUPS

The recaptures of banded bats by various workers have demonstrated a strong tendency for groups of individuals to remain together during considerable periods. These records have been summarized elsewhere (Griffin, 1940).

Table 2 shows the percentage of local returns taken at the four caves that I have visited most frequently. During each winter the bats were caught and banded at least twice at each cave. The great variability in the percentage recaptured can be largely explained by the difficulty in catching all the bats at the mines in Chester and Roxbury. I have estimated roughly

in the next to the last column the percentage of the bats present which I believe were captured each winter. In the last column I have estimated the total percentage that probably returned to each cave. This estimate is based on a method explained previously (Griffin, 1940). It is assumed that 0.5 young are born per adult per year, and that seven tenths of the young survive until winter.

TABLE 2.—Percentages of local returns to hibernation colonies

		NUMBER BANDED	PERCENT RETAKEN THE FOLLOWING WINTER	PERCENT OF BATS CAUGHT AT EACH VISIT (ESTIMATED)	PERCENT ACTUALLY RETURNING TO CAVE (ESTIMATED)
Chittenden, Vermont:					
Myotis lucifugus	1934–35	145	41.3%	90%	79%
Myotis sodalis	1934–35	367	31.1%	90%	59%
Myotis lucifugus	1935–36	85	35.4%	90%	67%
Myotis sodalis	1935–36	352	28.1%	90%	54%
Plymouth Union, Vermont:					
Myotis lucifugus	1934–35	14	50.0%	90%	95%
Myotis sodalis	1934–35	74	48.4%	90%	92%
Myotis lucifugus	1935–36	40	30.0%	90%	57%
Myotis sodalis	1935–36	32	31.2%	90%	59%
Roxbury, Connecticut:					
Myotis lucifugus	1936–37	384	30.7%	80%	74%
Myotis sodalis	1936–37	157	31.4%	80%	75%
Myotis keenii septentrionalis	1936–37	148	11.5%	80%	36%
Pipistrellus	1936–37	97	3.9%	80%	9%
Chester, Massachusetts:					
Myotis lucifugus	1936–37	933	8.0%	60%	34%
Myotis sodalis	1936–37	71	19.6%	60%	84%
Myotis keenii septentrionalis	1936–37	412	11.9%	60%	51%
Pipistrellus	1936–37	40	17.5%	60%	75%

G. E. Folk (unpublished) has shown that at a cave near Millerton, New York the bat population is constantly changing throughout the winter. Guthrie (1933) reported similar events in Missouri caves; and my own notes often show great fluctuations in the numbers of bats in various caves. Furthermore there are actual records of banded bats that moved from one cave to another during the winter (1940). Yet the great majority evidently come each year to the same cave to hibernate even though they may not remain there throughout the winter. The relatively high percentage of returns secured in homing experiments (1940) also provides evidence of this strong

tendency for bats to reassemble in the same groups after a seasonal change in their habits.

SEX RATIO

There is apparently a 1:1 sex ratio in *Myotis lucifugus* at birth (890 immature bats of this species have been banded at the buildings where they were born, and 450 of them were males). Yet at the caves where I have caught this species during hibernation there is a decided preponderance of males. At each of ten caves more than 100 *Myotis lucifugus* have been caught during a single day, the total for all ten caves being 3703. Of this total of 3703 bats, 2682 or 72.5% were males. The percentages of males at each of the ten caves were: 46.8%, 47.9%, 80.4%, 81.0%, 87.2%, 79.6%, 68.1%, 75.0%, 72.08%, and 88.0%. Where do all the females winter? I have found no evidence that they seek more sheltered retreats and are overlooked or that they are more difficult to capture. Perhaps they suffer a heavier mortality than the males and have in consequence a shorter average life span.

Out of 110 young *Eptesicus fuscus* that have been captured, 60 were males. At various caves 132 of this species have been taken, of which 58 were males; but this total is too small to be considered representative. Of 2289 hibernating *Myotis sodalis* 51.4% were males. Of 877 *M. keenii septentrionalis* taken in caves the percentage of males were 77.8%. Only 214 *Pipistrellus subflavus* were caught during hibernation and 73.5% of them were males. Mohr (1932 and 1939) has described Pennsylvania bat colonies where there is a similar unbalanced sex ratio.

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Biological Laboratories, Harvard University, Cambridge, Massachusetts

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NOTES ON ARKANSAS MAMMALS

BY S. C. DELLINGER AND J. D. BLACK

At the time of the preparation of a paper "Mammals of Northwestern Arkansas" by one of the present authors (Black, Jour. Mamm., vol. 17, pp. 29–35) a considerable share of the data from the University of Arkansas collection was not available. We now present these data together with additional records that have been accumulated since 1935. Unless otherwise indicated, the specimens listed here are preserved as skins in the University of Arkansas Museum.

Didelphis virginiana virginiana Kerr. Virginia opossum.—Several additional instances of unusual pelage have been recorded, including one cinnamon-colored animal from three miles south of Elkins, Washington Co., and one pure albino from near Mountain Home, Baxter Co. They were two of a lot of odd-colored specimens that were kept alive at the university for genetical experiments. Later, both were lost. We have data on several white opossums with black-tipped ears and toes, including two skins as follows: Three miles N. of Springdale, Washington Co., 1; near Eden's Bluff, Benton Co., 1. We also have a mounted cinnamon-colored specimen from Sulphur City, Washington Co., 1939.

Cryptotis parva (Say). Little short-tailed shrew.—Two of these were taken from a storm cellar (one preserved) one mile west of Fayetteville, Haskell Heights, Washington Co. Approximately twenty adults and young were taken by Eugene Cypert from post

holes at the Migratory Waterfowl Refuge at St. Charles, Arkansas Co., March 21, 1938. Three of these are preserved in the University of Arkansas Museum, as well as one from Big Island Chute, Arkansas Co., April 12, 1938.

Blarina brevicauda carolinensis (Bachman). Carolina short-tailed shrew.—Formerly known in northwestern Arkansas only from the crushed skeleton reported in 1935. Additional data now show that the species is not rare. Three specimens (all adults) were secured near Winslow, Washington Co., during the winter of 1937-38, two at the University Farm in 1927, and one near the University campus in 1934. Six were found (not preserved) in window wells at the United States Veterans Facility, Fayetteville, Washington Co., October, 1938. One was reported by Harold Wales as coming from Mammoth Springs, Fulton Co., 1939.

Myotis grisescens A. H. Howell. Gray bat.—Bella Vista Cave, Benton Co., 2; Crystal Cave, five miles N. of Bentonville, Benton Co., 12.

The breeding colony in Denney Cave, reported in 1935, is much smaller than in former years, a condition that holds true for all the bats in this section. This diminution in numbers is probably due to the severe drought in the summer of 1935.

Myotis keenii septentrionalis (Trouessart). Eastern long-eared bat.—Three of these bats were collected April 25, 1938, at Crystal Cave, five miles N. of Bentonville, Benton Co., by Eugene Crawley. Apparently this is the third record from Arkansas and the second record with definite locality. Miller and Allen (Bull. U. S. Nat. Mus. no. 144, p. 106, 1928) mentioned one from Delight, and two from "Arkansas".

Eptesicus fuscus fuscus (Beauvois). Big brown bat.—Big brown bats were found in large numbers at Devil's Den, 9 miles west of Winslow, Washington Co., in October, 1935.

Lasiurus cinereus (Beauvois). Hoary bat.—Trut Holder, University of Arkansas taxidermist, collected three of these at Little Rock, Pulaski Co., in June, 1932. These specimens went by exchange to a Mr. Bartineck of Chicago. Before 1928 the species was fairly common during the summer at Winslow but has not been known there since. Apparently the Little Rock specimens form the only definite record from Arkansas.

Euarctos americanus americanus (Pallas). American black bear.—A black bear was killed near Holly Grove, Phillips Co., during the 1927 flood, which drove it out of the cane brakes. One skull and part of a skeleton of a black bear was taken from the White River bluffs on the John Berry Graham farm, 8 miles east of Springdale, Washington Co., during archaeological explorations in 1929. Trut Holder reports one sight record at the Scrub Grass Bayou, Migratory Waterfowl Refuge, Arkansas Co., October, 1938.

Procyon lotor hirtus (Nelson and Goldman). Missouri Valley Raccoon.—We have secured specimens as follows: West Fork of White River, 5 miles southeast of Fayetteville, Washington Co., 1; six miles west of Goshen, Washington Co., 2; West Fork, Washington Co., 1; near War Eagle, Benton Co., 1; Clark Co., 2.

Mustela vison mink (Peale and Beauvois). Mink.—To the few definite records of this species in Arkansas should be added a large male now mounted in the University of Arkansas Museum; collected near Augusta, Woodruff Co., December, 1935, by Roy Wood, Museum taxidermist, and three taken near Cave Springs, Benton Co., 1938.

Lutra canadensis interior (Swenk). Interior otter.—One tanned skin, without skull, of an otter trapped near Helena, Phillips Co., in December, 1929, is now in the Museum. One was examined in the hands of a trapper on Big Piney Creek, Pope Co., in 1926. We have authentic sight records from near Monticello, Drew Co., in October, 1935, and from Spavinaw Creek, near Gravette, Benton Co., in May, 1937. These animals are fairly common on Spavinaw Creek since Arkansas has closed the season on them. Several complaints have been made that the otters are ruining fishing in this stream. Eugene Cypert, Biologist, White River Migratory Waterfowl Refuge, reports them as increasing in Desha and Arkansas counties.

Spilogale interrupta (Rafinesque). Prairie spotted skunk.—All the specimens and

skins we have examined seem fairly typical of this form. The species apparently reaches its eastern limit, in this state, at Hot Springs where it is reported common; however, we do not have specimens from that locality. Museum specimens include: Fayetteville, Washington Co., 1 mounted and 1 tanned skin; 2 miles west of Sulphur City, Washington Co., 1 mounted; Marble Falls, Boone Co., 1 skin.

Mephitis mephitis mesomelas (Lichtenstein). Louisiana skunk.—In December, 1936, Dellinger examined three pure albino skunks in the possession of Doctor Henry Kirby of Harrison, Boone Co. A nest with four young was found on Clear Creek, five miles north of Fayetteville, Washington Co., in May, 1935. These together with adults from that locality are mounted in the museum or preserved as skins. There is also a skin from four miles southwest of Fayetteville, Washington Co.

Mustela primulina Jackson. Missouri weasel.—The museum has one skin from near Fayetteville. Gene Rush, of the museum staff, examined a white skin in the hands of a trapper at Marble Falls, Boone Co., in January, 1938.

Vulpes fulva (Desmarest). Eastern red fox.—A good series of red foxes is now in the museum, taken during the winter of 1937-38 in predatory control work in the State Game Refuge near West Fork, Washington Co. Also one skin from south of Durham, Washington Co., one from near Winslow, Washington Co., and one from nine miles south of Prairie Grove, Washington Co.

Urocyon cinereoargenteus cinereoargenteus (Schreber). Eastern gray fox.—Specimens as follows: near Berryville, Carroll Co., 2 (mounted); near Newport, Jackson Co., 2; three miles north of Gravette, Benton Co., 1; near Fayetteville, Washington Co., 1; and State Game Refuge, near West Fork, Washington Co., 10.

Canis latrans subsp. Coyote.—The museum has one coyote skin (without skull) from Cincinnati, Washington Co., taken in January, 1924. Puppies from a den on Kessler Mountain, west of Fayetteville, Washington, Co., were offered for sale in the streets of Fayetteville in June, 1922.

Canis rufus gregoryi (Goldman). Mississippi Valley wolf.—Wolves are becoming rather common in the Ozarks. Many skins pass through the hands of fur traders each winter. According to game wardens they are found in the game refuges throughout the state. One from Kessler Mountain, near Fayetteville, Washington Co., was examined in the possession of a dealer in January, 1936, as well as several from near Schaberg, Crawford Co., and from the Devil's Den region, west of Winslow, Washington Co. We have a skin of one large male caught by a government trapper in 1936 near St. Joe, Searcy Co., and another from near Summer, Washington Co., also taken by a government trapper. Two black wolves, a male (length 58½ inches) and a female (length 42¾ inches) were taken by game warden Bland in the Big Woods Game Refuge, Howard Co., in September, 1939.

Lynx rufus rufus (Schreber). Bobcat.—Two were taken near Alabam, Madison Co., in October, 1922, and sent to Ward's Natural Science Establishment, Rochester, New York. The museum has the following specimens: Near Alabam, Madison Co., 1; two miles north of Cass, Franklin Co., 1 (mounted); near Marble Falls, Boone Co., 2; State Game Refuge near Graysonia, Clark Co., 2; State Game Refuge, near Umpire, Howard Co., 1.

Marmota monax monax (Linnaeus). Southern woodchuck.—Five miles east of Cass, Franklin Co., 1; Marble Falls, Boone Co., 1; six miles north of Elkins, Washington Co., 1. Dellinger saw one albino in captivity at Yellville, Marion Co., 1938.

Tamias striatus venustus (Bangs). Southwestern chipmunk.—Clear Creek, five miles north of Fayetteville, Washington Co., 1; Beaver Dam, Crawford Co., 1; Cass, Franklin Co., 1.

Geomys breviceps breviceps (Baird). Louisiana pocket gopher.—Magnolia, Columbia Co., 3 skins, 18 alcoholic; near Mansfield, Sebastian Co., 1 alcoholic.

Reithrodontomys fulvescens aurantius (Allen). Golden harvest mouse.—Barling, Sebastian Co., 2; near Cass, Franklin Co., 1.

Peromyscus leucopus noveboracensis (Fischer). Northern white-footed mouse.—Fayetteville, Washington Co., 2; five miles southeast of Fayetteville, 2; near Cass, Franklin Co., 1.

Peromyscus gossypinus megacephalus (Rhoads). Rhoads cotton mouse.—Barling, Sebastian Co., 6; Fourche Bayou, near Little Rock, Pulaski Co., 12; Russellville, Polk Co., 5.

Peromyscus boylii attwateri (Allen). Attwater's white-footed mouse.—Natural Dam, Crawford Co., 2.

Peromyscus nuttalli aureolus (Audubon and Bachman). Southern golden mouse.—One skin and skull, adult male, collected by Trut Holder, March 14, 1939, Island No. 80, Chicot Co.; one from one-half mile west of Fayetteville, Washington Co.

Oryzomys palustris texensis (Allen). Texas rice rat.—Fourche Bayou, near Little Rock, Pulaski Co., 3; Stuttgart, Arkansas Co., 1.

Sigmodon hispidus hispidus (Say and Ord). Eastern cotton rat.—Fourche River Bottom, near Little Rock, Pulaski Co., 10.

Neotoma floridana attwateri (Mearns). Attwater wood rat.—Near War Eagle, Benton Co., 1.

Pitymys nemoralis (Bailey). Woodland pine mouse.—Barling, Sebastian Co., 1; Beaver Dam, Crawford Co., 1; Cass, Franklin Co., 1; Fourche Bayou, near Little Rock, Pulaski Co., 1.

Ondatra zibethica zibethica (Linnaeus). Common muskrat.—Mammoth Springs, Fulton Co., 2; near Elm Springs, Benton Co., 2. We have in addition numerous sight records from around Fayetteville, Washington Co., including Fayetteville Junction, Roacher's Pond and Clear Creek; also a nest seen at Roacher's Pond during 1922, 1923, and 1924. Muskrats seem to be increasing in numbers in the Ozarks.

Lepus californicus melanotis (Mearns). Great plains jack rabbit.—Four young jack rabbits were taken from a clump of blue stem grass late in April, 1937, one-half mile west of Tontitown, Washington Co. Two of these were raised to adulthood in captivity and were observed several times by Dellinger. In addition we have several authentic sight records for this animal in northwestern Arkansas, including one killed on highway 45, eight miles east of Fayetteville, Washington Co.; several one mile south of Farmington, Washington Co.; repeatedly on Dellinger farm on Clear Creek, five miles north of Fayetteville, Washington Co.; very common south of Gravette, Benton Co.; and observed just recently about two miles south of Evansville, Crawford Co. We have lately secured one from five miles northwest of Prairie Grove, Washington Co., on Muddy Fork of the Illinois River, and one from near Gravette, Benton Co.

Sylvilagus aquaticus aquaticus (Bachman). Swamp rabbit.—White River, near Augusta, Woodruff Co., 2; Stuttgart, Arkansas Co., 1.

Odocoileus virginianus subsp. Virginia deer.—Five Lakes Hunting Club, Crittenden Co., 3 (mounted); Fourche Mountains, Yell Co., 2 (skins and skulls). In addition one was killed seven miles north of Fayetteville, Washington Co., on the Springdale Golf Course in 1937, but was not preserved.

Dasypus novemcinctus texanus (Bailey). Texas nine-banded armadillo.—A live armadillo was taken from a brush pile near Cane Hill, Washington Co., by a farmer in the fall of 1921. We were unable to purchase this specimen from the owner. There are additional reports of this animal from Barling, Sebastian Co., and Paris, Logan Co., as well as numerous reports of its occurrence in Miller and Little River counties in the vicinity of Texarkana. Apparently the species is well established in extreme southwestern Arkansas. One caught near Altus, Franklin Co., was examined August 20, 1938, but was too badly decayed to preserve. Doctor Pink Carrigan of Hope reports that armadillos have been breeding in Hempstead Co., for the past two or three years. We

have a mounted specimen, trapped by Carl Lewis at the entrance of its burrow, two miles east of Durham, Washington Co. This specimen was apparently overcome by cold during the night.

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University of Arkansas Museum, Fayetteville, Arkansas.

THE NOMENCLATURE AND TYPE LOCALITIES OF CERTAIN OLD WORLD MAMMALS[1]

By Francis Harper

Recent studies on some of the larger and rarer of the Old World Mammals have disclosed a surprising amount of confusion in their nomenclature. This seems to have resulted, in the main, from lack of proper attention to the type descriptions and the type localities.

About 70 names are discussed in the following pages.

DASYURIDAE

Mustela quoll Zimmermann

Iredale and Troughton (Australian Mus. Mem. 6, p. 12, 1934) endeavor to resurrect *Mustela quoll* Zimmermann (Spec. Zool. Geog. Quadr., p. 489, 1777) as the earliest valid name of the common eastern native cat of Australia, long known as *Dasyurus viverrinus* (Shaw). Zimmermann gives as a reference "*Cooks Voyag.* round the World in *Hawkesworth's Collection.* T. 3. p. 626". This reference is apparently to the first edition, in which volumes 2 and 3 are continuously paged. His meager accompanying description adds nothing to that in Hawkesworth (Account of Voyages by Byron, Wallis, Carteret, and Cook, [ed. 2,] vol. 3, p. 222, 1773):

"Of the quadrupeds . . . I can add only one more, resembling a polecat, which the natives call Quoll; the back is brown, spotted with white, and the belly white unmixed."

This description evidently applies as well (perhaps even better) to the large spotted-tailed tiger-cat, *Dasyurus maculatus* (Kerr), as to *D. viverrinus.* Under these circumstances it appears best to discard Zimmermann's *quoll* as indeterminable.

Didelphis viverrina Shaw (Gen. Zool., vol. 1, pt. 2, p. 491, pl. 111, 1800) is actually a composite species, being based in part upon "The Tapoa Tafa" of White (Jour. Voy. New South Wales, p. 281, pl. 58, 1790), and in part upon "The Spotted Opossum" of Phillip (Voy. Botany Bay, p. 147, pl. 15, 1789). The former is *Phascogale tapoatafa tapoatafa* (Meyer). By long usage Shaw's name *viverrina* has become restricted to the latter component. Thus *Dasyurus viverrinus* (Shaw) may be allowed to stand as the valid name of the common eastern native cat.

MACROPODIDAE

Thylogale flindersi Jones

The original reference for the Flinders Island wallaby is: *Thylogale flindersi* Jones, Mammals South Australia, pt. 2, p. 240, fig. 171 (left), 1924. Here the species is validly

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[1] This communication is a by-product of an investigation of extinct and vanishing mammals, which has been sponsored by the American Committee for International Wild Life Protection and supported in part by a grant from the Penrose Fund of the American Philosophical Society.

described, though not labeled as new. This publication is listed in the supplement to Nature for October 25, 1924, and in the Journal of Mammalogy, vol. 6, p. 64, February [9], 1925. The actual date of publication could scarcely have been later than October 1, 1924.

The same name was proposed as a new species by Jones in the Transactions of the Royal Society of South Australia, vol. 48, p. 12, December 24, 1924. The original reference is erroneously cited from this later publication in the Zoological Record for 1925 (Mammalia, p. 54); likewise by Iredale and Troughton (Australian Mus. Mem. 6, p. 46, 1934).

LEMURIDAE

Microcebus rufus Wagner

Schwarz (Proc. Zool. Soc. London 1931, p. 403, 1931) attempted to apply this name to the eastern subspecies of *Microcebus murinus* (J. F. Miller). He remarks: "This name is based upon the *Microcèbe roux* of E. Geoffroy and is clearly applicable to the red eastern race." He also adds in a footnote: "*Microcebus rufus* Wagner, Schreber, Säugth., Suppl. i., p. 291 (footnote) (1840); see also Wagner, *l. c.* p. 278 (*Microcèbe roux* Geoffr., in synonymy)." (Incidentally, the actual date of Wagner's name is 1839; *cf.* Sherborn, Proc. Zool. Soc. London 1891, p. 591, 1892).

However, Wagner's only use or mention of the name *rufus* is comprised in the following footnote on page 291: "Der *Galago madagascariensis* von Geoffroy und Desmarest ist unser *Microcebus rufus*." Thus the only possible disposition of his name would seem to be as a still-born synonym of *Galago madagascariensis* E. Geoffroy-Saint-Hilaire (1812). The latter name is placed by Schwarz himself (p. 402) in the synonymy of *Microcebus murinus murinus* (J. F. Miller).

The next available name for the eastern subspecies of Miller's dwarf lemur is apparently *Cheirogaleus smithii* J. E. Gray (Ann. Mag. Nat. Hist., vol. 10, p. 257, 1842). The current name will then stand as *Microcebus murinus smithii* (J. E. Gray). The type locality, originally given merely as "Madagascar," may be restricted to "a few miles north of Fianárantsóa," central Betsileo, where the animal was reported as abundant by Shaw (Proc. Zool. Soc. London 1879, p. 135, 1879).

CANIDAE

Canis hodophilax Temminck

The original description of the Japanese wolf seems to have been almost completely overlooked, even by Sherborn (Index Animalium 1801–1850). The name *Canis hodophilax* was first published by Temminck in the Tijdschrift voor Natuurlijke Geschiedenis en Physiologie (pt. 5, p. 284, 1839); the type locality is Japan (*i.e.*, Hondo). The description given here, though brief, is perfectly valid nomenclaturally. Temminck furnishes a similar description in Siebold's Fauna Japonica, Mammifères (p. 5, 1842), and a more complete and formal description at another place (pp. 38–39, 1844) in the same work. (For the dates of the various parts of this work, see Sherborn and Jentink, Proc. Zool. Soc. London 1895, p. 149, 1895.) The original reference is given correctly by Schrenck (Reisen und Forschungen im Amur-Lande, vol. 1, p. 46, 1859), but in later works it has been generally cited from page 38 in the Fauna Japonica. Here the species is presented as "Chien hodophile. *Canis hodopylax*." But the spelling *hodophilax* occurs not only in the original reference, but also on page 5 and on plate 9 of the Fauna Japonica; furthermore, the spelling of the French common name suggests that *hodophilax* was the spelling intended by Temminck for the technical name. Thus *hodopylax* may be regarded as a typographical error, as Pocock has already pointed out (Proc. Zool. Soc. London 1935, p. 658, 1935). It has been commonly emended to

hodophylax (*e.g.*, by Mivart, Lydekker, Thomas, Aoki, Hatta, and Pocock); but recently Kuroda (List Japanese Mammals, p. 36, 1938) has reverted to "*hodopylax*."

The name *hodophilax* is evidently derived from ὁδός (trail) + φύλαξ (watcher), and the proper Latin transliteration of the Greek would have been *hodophylax*. Though Temminck's etymology is slightly at fault, his spelling of *hodophilax* in the original description and elsewhere is evidently not a typographical error, and it should therefore stand.

FELIDAE

Felis catus morea Trouessart

I. Geoffroy Saint-Hilaire (in Bory de Saint-Vincent, Expédition Scientifique de Morée, vol. 3, pt. 1, zool., p. 13, 1833, and atlas, ser. 3, zool., pl. 1, A, 1833) furnishes a description and a finely executed plate of "*Felis catus ferus* Lin., variété de Morée." The words "*ferus* Lin." on the plate are printed on a slip of paper pasted over the words "*domesticus* L." The only technical name appearing in the text is "*Felis Catus*." The specimen referred to was secured near Mt. Diaphorti, in the Peloponnesus, Greece (Morée being French for Morea or the Peloponnesus).

H. G. L. Reichenbach, in a set of colored plates, issued possibly in 1837, gives a colored figure (in reverse) of the same animal (pl. 80, fig. 639). This set of 24 plates (nos. 79-102), apparently without names or accompanying text (at least no such text is found with the set in the library of the Academy of Natural Sciences of Philadelphia), is inserted loosely (apparently in the nature of a supplement) at the back of a bound set of 78 plates, issued at Leipzig in 1836 under the title of "Praktisch-gemeinnützige Naturgeschichte der Säugthiere des In- und Auslandes, Kupfersammlung, erster Theil mit 633 Abbildungen der Raubsäugthiere." As Wood remarks (Introd. Literature Vert. Zool., p. 531, 1931), "The numerous faunal. . . .works of this important. . . . naturalist. . . .are commonly regarded with despair by the cataloguer."

According to the Catalogue of the Library of the British Museum (1913), Reichenbach had issued at Dresden and Leipzig in 1834(?) the following work: Die vollständigste Naturgeschichte des In- und Auslandes [Sect. 1, Säugethiere, vol. 4], Raubsäugethiere, pp. xxviii + 348, 102 col. pl. I have not seen this original edition, but the Academy of Natural Sciences of Philadelphia has a second edition of 1852, with pages xii + 398. This edition consists of text only, although the title-page states: "Mit 751 Abbildungen auf 102 Kupfertafeln." This is exactly the number of figures and plates comprised in the two combined sets mentioned above, published in 1836 and 1837(?). In this work (p. 362) Reichenbach lists "*Felis catus ferus* L. var. e Morea," with references to his own figure 639 of 1837(?) and to "Bory St. Vincent Exped. pl. 1. A." The words "var. e Morea," printed in ordinary Roman instead of in the wide-spaced type of "*Felis catus ferus*," do not form a part of the name; they are a simple Latin translation of Geoffroy Saint-Hilaire's "variété de Morée."

Nevertheless, Matschie (Sitz.-ber. Gesell. Naturf. Freunde Berlin 1895, p. 192) cites "*F. morea* Rchb." This is apparently the first appearance of the name in zoological nomenclature, but I consider it a *nomen nudum* in this place. "Rchb." can hardly be considered a sufficiently definite reference or indication to validate the name. Even if it were, Matschie would necessarily be credited with the authorship.

Trouessart (Catalogus Mammalium, p. 360, 1897) uses the name "*Felis catus* var. *morea*, Reich." Here again there is no citation of Reichenbach's work, and there is the same objection to the validation of *morea* as in the case of Matschie's citation, for there is no accompanying description. However, in the 1904 supplement (p. 273) Trouessart lists "[*Felis catus*] *morea*, Reichenb., Vollst. Naturg., Raubth., 1852; Matschie, S.-B. Ges. Naturf. Berl., 1895, p. 192." This then, may be taken as the first

valid use of the name *morea*, on the ground of a fairly adequate reference to Reichenbach's work. The original reference may accordingly be cited as: [*Felis catus*] *morea* Trouessart, Catalogus Mammalium, quinq. suppl., fasc. 1, p. 273, 1904 (*ex* Reichenbach, Vollständigste Naturgeschichte, Raubsäugethiere, p. 362, 1852, *ex* Bory de Saint-Vincent, Expédition Scientifique de Morée, atlas, ser. 3, zool., pl. 1, A, 1833). The type locality is above Dragomanou, near Mt. Diaphorti, west central Morea (Peloponnesus), Greece.

While this note may help to clear up a long-standing nomenclatural tangle, it does not presume to pass upon the taxonomic status of the Peloponnesian wildcat. This problem may be left to those who may have the requisite specimens at their disposal. It may be remarked that Miller (Cat. Mammals Western Europe, p. 463, 1912) regards a skin from Athens, Greece, as indistinguishable from *F. s. silvestris* Schreber.

Felis virgata Illiger

The earliest name for the Persian tiger is *Felis virgata* Illiger (Abhandl. K. Akad. Wiss. Berlin, 1804–11, phys. Kl., pp. 90 and 98, 1815). The brief accompanying description (p. 98) is as follows: "Der nordliche kleinere mehr graue Tiger, in Persien und am Kaspischen Meere, scheint einer besondre Art zu bilden, die ich *Felis virgata* nenne." However inadequate this description may be, it suffices to validate the name proposed by Illiger. The type locality is hereby restricted to the Province of Mazanderan, northern Persia.

Matschie (Sitz.-ber. Gesell. Naturf. Freunde Berlin 1897, p. 17, 1897) accepts *Felis virgata* Illiger as the valid name of the tiger of the Aral-Caspian region. Lydekker (Game of Europe, Western & Northern Asia, and America, p. 287, 1901) likewise accepts it. Nevertheless, a number of more recent authors, treating Illiger's name as a *nomen nudum*, or at least as indeterminable, have credited *virgata* to Matschie (*cf.* Satunin, Mitteil. Kaukas. Mus., vol. 4, p. 250, 1909; Pocock, Jour. Bombay Nat. Hist. Soc., vol. 33, p. 519, 1929; Ognev, Mammals of USSR and Adjacent Countries, vol. 3, p. 273, 1935).

Felis (*Tigris*) *tigris septentrionalis* Satunin (Priroda i Ochota, vol. 7, p. 5, 1904; type locality, mineral springs 12 versts west of Lenkoran, Talish, Transcaucasia) is considered valid by Satunin (Mitteil. Kaukas. Mus., vol. 4, p. 250, 1909) and by Pocock (Jour. Bombay Nat. Hist. Soc., vol. 33, p. 519, 1929), on the ground that *Felis virgata* "Matschie" (1897) is preoccupied by *Felis virgata* Nilsson (1829), the latter name having been proposed for a Norwegian lynx. Satunin (Mitteil. Kaukas. Mus., vol. 2, pp. 309–313, 1906) also maintains that Illiger's description is not applicable to the Caspian tiger, although he grants that the summer pelage of this animal is distinctly paler than that of the Bengal tiger, and that the winter pelage is dirty yellowish brown. Both Satunin and Pocock show that the stripes in some Caspian tigers are not black, as in the Bengal tiger. Pocock adds (p. 522): "It may be inferred that this [Caspian] race of tigers is not larger, possibly it is on the average somewhat smaller than the typical Indian race." Thus it is quite conceivable that Illiger may have had before him one or more Caspian or Persian tigers to which his brief description did apply.

Under these circumstances I believe that *Felis virgata* Illiger should be accepted as the original reference for the Persian tiger, while Satunin's *septentrionalis* becomes a synonym. In current usage the name will then stand as *Panthera tigris virgata* (Illiger).

Tigris longipilis Fitzinger

In describing this animal, Fitzinger (Sitz.-ber. K. Akad. Wiss. Wien, Math.-naturw. Cl., vol. 58, pt. 1, pp. 455–457, 1868) does not specify any type locality, but gives the range as follows: "Korea and Japan through northern China, Manchuria, Mongolia,

and Dzungaria north to southern Siberia, and west through northern Tatary, Bokhara, and northern Persia to Mount Ararat in western Armenia." His description was evidently based upon a specimen "im kaiserl. zoologischen Museum zu Wien," which may be regarded as the type.

The provenance of this specimen is therefore a matter of primary importance in fixing the type locality and determining the application of the name *longipilis*. If its exact provenance is not ascertainable at this late date, at least an examination of the specimen itself (if still extant) should give some clue to the approximate area of its origin. So far I have been unable to obtain any information concerning the specimen from the Naturhistorisches Museum in Wien.

Until the possibility of obtaining such information is exhausted, any attempt to arbitrarily restrict the type locality may be regarded as premature. Lydekker (Game of Europe, Western & Northern Asia, and America, p. 288, 1901) virtually makes such an attempt in referring to "the tiger of Amurland" as "the typical representative of this race [*longipilis*]." Apparently overlooking Lydekker's action, and for no very plausible reason, Pocock (Jour. Bombay Nat. Hist. Soc., vol. 33, p. 529, 1929) regards "the name *longipilis* as applicable to the tigers of the intermediate area" between Amurland and Transcaspia. Pocock also proposes (p. 527) to recognize *Felis tigris* var. *amurensis* Dode (Proc. Zool. Soc. London 1871, p. 480, 1871) as the original designation of the Manchurian tiger. In this he is followed by G. M. Allen (Mammals China and Mongolia, pt. 1, p. 487, 1938). However, I find nothing whatever in Dode's brief description (barely more than one line in length) to differentiate his animal from Fitzinger's *longipilis*.

Pending the possible receipt of additional information concerning the type of *longipilis*, I would apply the name *Panthera tigris longipilis* (Fitzinger) to the Manchurian tiger and reduce Dode's *amurensis* to synonymy.

EQUIDAE

Equus przewalskii Poliakov

The Mongolian wild horse was named *Equus przewalskii* by Poliakov (Izviestiia Imper. Russk. Geogr. Obshchestvo, vol. 17, p. 1, 1881). It is important that the type locality should be fixed, if possible, more exactly than it is in the original description, which merely states that the type specimen was obtained by a "hunting expedition sent by M. Tihonof from the post Zaisan to the sand deserts of Central Asia, in quest of wild camels" (Poliakof, Ann. Mag. Nat. Hist., ser. 5, vol. 8, p. 19, 1881).

According to Salensky (Wiss. Resultate der von N. M. Przewalski nach Central-Asien Unternommenen Reisen, Zool., vol. 1, Mammalia, sect. 2, Ungulata, no. 1, p. 2, 1902), who monographed the species, the type specimen was killed "in the steppes of eastern Dzungaria." Unless some valid objection is found, this restriction of type locality should prevail, as far as it goes, against any later and contrary restriction.

Matschie (Naturwiss. Wochenschr., vol. 18, no. 49, p. 583, 1903) describes *Equus hagenbecki* from Ebi Spring (in the Gobi Desert near the route from Kobdo to Barkul), from Njursu (near Gashun, northeast of Guchen), and from the Urungu River region (northern Dzungaria). At the same time he attempts to restrict the range of *E. przewalskii* to more easterly and southerly areas, from Zagan Nor (in the "southern" [=northeastern] spurs of the Altai, about 450 km. southeast of Kobdo) and the Baitik-Bogdo Mountains (about lat. 45° 30′ N., long. 91° E.) possibly south to the Lob Nor region. Lydekker (Cat. Ungulate Mammals Brit. Mus., vol. 5, p. 7, 1916) and Schwarz (Jahrb. K. Preuss. Geol. Landesanstalt Berlin 1927, vol. 48, p. 461, 1928) reduce *hagenbecki* to the synonymy of *przewalskii*.

Lydekker's statement (1916, p. 7) regarding *przewalskii*: "typical locality Eastern Gobi, Zungaria," is, at first glance, rather incomprehensible, since the eastern Gobi

is a thousand miles from Dzungaria; but Lydekker had a remarkable propensity for confusing east and west.

Apparently the first additional specimens, after the type was obtained from an indefinite locality, were collected in 1889 at the oasis of Gashun (approximately lat. 44° 30′ N., long. 90° E.), northeast of Guchen, in the desert or steppe country between the Bogdo-Ola and the Baitik-Bogdo (Wrangel, Die Rassen des Pferdes, vol. 1, p. 2, 1908). Matschie reports (1903, p. 583) that the skull of the type of *przewalskii* is very similar to a skull from Gashun. Thus Gashun would appear to be a suitable choice for a restricted type locality, and I propose it as such. This corroborates Salensky's original restriction to the steppes of eastern Dzungaria, but makes it more explicit.

Hilzheimer (Naturwiss. Wochenschr., vol. 24, no. 51, p. 812, 1909) proposes "Altai s. Kobdo" as the range of *przewalskii*, and "Urungu" as that of *hagenbecki*. In the same paper (p. 810) he also proposes to resurrect "*Equus equiferus* Pallas" as the original designation of the Mongolian wild horse, in the belief that this name had remained in complete oblivion since Pallas's time. However, he overlooks J. E. Gray's citation (Gleanings from Knowsley Menagerie, p. 70, 1850) of "[*Equus Caballus*] var. *Equiferus* Pallas" and Poliakov's citation (Izviestiia Imper. Russk. Geogr. Obshchestvo, vol. 17, p. 6, 1881) of "*Equus Equiferus*" as from Pallas. Hilzheimer also considers that the range of "*Equus equiferus typicus*" is at "Zagannor," on account of a certain agreement between Pallas's description and the characters of the wild horses occurring at Zagan Nor. He offers no evidence, however, that Pallas had been to that locality.

At this point it will be well to look into Pallas's own use of "*Equiferus*." In the Zoographia Rosso-Asiatica (vol. 1, p. 255, 1831), under the heading of *Equus caballus*, he writes farther down on the same page: "B. Equiferus, Plin. Gmelin. (jun.) itin. I. p. 44, tab. 9. Pallas itin. I. p. 211, III. p. 510. tab." On page 256 "*Equiferus*" is mentioned again, and on page 260 we have "*Equiferi*." In each case the word stands quite by itself. Elsewhere (Spic. Zool., p. 5, 1779) Pallas writes of "*Equi feri*." A careful study of these and analogous cases in Pallas convinces me that they are not valid examples of binominal nomenclature, but merely Latin descriptive terms or loosely quoted references. Consequently I do not believe that "*Equus caballus equiferus*" can be cited from Pallas. It is worth noting that Sherborn (Index Animalium 1801–1850) does not cite *equiferus* from any author. Apparently Gray (1850) was the first author to employ the name *equiferus* in a nomenclaturally valid sense, and in that case he must be regarded as the authority for the name. He introduced it as a synonym of *Equus caballus*, and it is perhaps best that it should remain in that status. Schwarz (Jahrb. K. Preuss. Geol. Landesanstalt Berlin 1927, vol. 48, p. 450, 1928) likewise disposes of the "*Equiferus*" of Pallas as a synonym of *caballus*. Thus Hilzheimer's attempt to apply this name to the wild horse of Zagan Nor, Mongolia, can not be considered valid. Pallas's description evidently applies to the Russian Tarpan, which is generally regarded as having received a certain admixture of blood from feral domesticated horses.

Antonius (Verh. Zool.-Bot. Gesell. Wien, vol. 62, pp. (64), (71), and (73), 1912, and Naturwiss. Wochenschr., vol. 27, no. 33, p. 516, 1912) cites "*Equus ferus* Pallas" and makes *E. przewalskii* Poliakov a synonym. But no "*Equus ferus*" can be found in Pallas, and the suggestion of Antonius (p. (73), footnote) that "*Equiferi*" is a typographical error for "*Equi feri*" is untenable when one considers that Pallas's expression "*Equiferus*" occurs in a number of places. If this word were separated into two words, the first would be plural, and the second singular. Thus Antonius must stand as author of the present "*Equus ferus*," which, however, is preoccupied by Boddaert (Elenchus Animalium, p. 159, 1785). Lydekker (Cat. Ungulate Mammals Brit. Mus., vol. 5, p. 6, 1916) also attempts to cite "*Equus ferus* Pallas" from the Zoographia Rosso-Asiatica, with total lack of justification.

Schwarz (Jahrb. K. Preuss. Geol. Landesanstalt Berlin 1927, vol. 48, p. 462, 1928), in the belief that the type of *E. przewalskii* is not an entirely pure-blooded wild animal, endeavors to restrict the name to "the wild component of the Mongolian Tarpan." In the case of a description of a composite *species*, it is permissible to restrict the name to a cotype representing a single species included within the composite species. It may be seriously questioned, however, whether names based upon hybrids or animals of mixed ancestry can be properly applied to any pure-bred species or subspecies. While Schwarz's action is thus of very doubtful validity, I would suggest, in the absence of any clear proof that the type specimen of *E. przewalskii* is mixed with domesticated blood, that the name be retained for the pure-bred wild animal.

Equus hemionus Pallas

The original reference for the Mongolian wild ass is: *Equus hemionus* Pallas, Nov. Comm. Acad. Sci. Imper. Petropolitanae, vol. 19, p. 394, pl. 7, 1775. The type locality is "ad Lacum Tarei Davuriae"; *i.e.*, Tarei Nor, on the Siberian-Mongolian boundary, about lat. 50° N., long. 115° E. Lydekker (Cat. Ungulate Mammals Brit. Mus., vol. 5, p. 11, 1916) is entirely in error in giving "Altai" as the type locality. It was perhaps this error that led Andrews (Natural History, vol. 24, p. 153, 1924) to believe that his encounter with the species in the central Gobi "extended the known range . . . several hundred miles to the east." Schwarz also (Jahrb. Preuss. Geol. Landesanstalt Berlin 1927, vol. 48, p. 459, 1928) is in error in giving "Dalai Nor" as the type locality.

Equus onager castaneus Lydekker (Novit. Zool., vol. 11, no. 2, p. 590, pl. 18, 1904) was based upon a captive specimen living at Woburn Park, England, in 1904; its provenance was "said to be Kirghis-Nor, Kobdo, Western Mongolia," but Lydekker admitted later (Horse and its Relatives, p. 183, 1912) that "the locality is doubtful." The practice of basing names upon living captives, and especially upon those of uncertain origin, has been appropriately criticized by Hollister (U. S. Nat. Mus. Bull. 99, pt. 1, p. 150, 1918). Schwarz (Zool. Garten, n. F., vol. 2, nos. 4–6, p. 92, 1929) relegates *castaneus* to the synonymy of *Asinus hemionus hemionus* (Pallas), and this is probably the most satisfactory disposition of the name.

Lydekker (Proc. Zool. Soc. London 1904, vol. 1, pp. 431–432, pl. 27, 1904) describes and figures, under the name of *Equus hemionus* Pallas, a captive specimen living at Woburn Abbey, England, and "stated to have been obtained as a colt in Kobdo, north-west of the Gobi Desert." Lydekker refers to it later (Novit. Zool., vol. 11, no. 2, p. 587, 1904) as a "specimen from north-eastern [=northwestern] Mongolia." He then adds: "The exact locality where this particular specimen was obtained (by the members of an expedition sent out by Mr. Carl Hagenbeck, of Hamburg), is the neighbourhood of Lake Balkash in Central Kobdo, north-western Mongolia, a spot lying east-north-east of Tarbogatai, the well-known hunting locality." It is difficult to comprehend how such a chaotic statement of locality could have been made, for Lake Balkash is in Russian Turkestan at a distance of approximately 600 miles from Kobdo, Mongolia. Kobdo, which was visited by the Hagenbeck expedition, is doubtless the locality that was meant.

Without any examination of the above-mentioned specimen, but merely on the basis of Lydekker's description and plate, Matschie (in Futterer, Durch Asien, vol. 3, pt. 5, Zoologie (Nachtrag), p. 23, 1911) proposes for it the name of *Equus* (*Asinus*) *hemionus bedfordi*. This solitary and apparently not fully adult specimen, in comparison with typical *hemionus* from northeastern Mongolia, has a general color of "pale sandy fawn" rather than of reddish yellow, and isabelline rather than whitish light areas. In general, however, it appears to be very similar to the wild asses of the central Gobi, of which Andrews (Natural History, vol. 24, pp. 152–156, 1924) presents such effective photographs.

Schwarz (Zool. Garten, n. F., vol. 2, nos. 4–6, p. 91, 1929) recognizes *bedfordi* as the name of the Transcaspian wild ass, but apparently under a misconception as to the type locality. For he extends the range of *bedfordi* eastward "to the western slope of the Altai. There begins the range of the Mongolian chigetai (*A. h. hemionus*)." Thus he assigns to *bedfordi* a range that does not include the type locality, which is Kobdo, northwestern Mongolia. Furthermore, if the animal of northwestern Mongolia should prove to be distinct from typical *hemionus*, the name *castaneus*, with seven years' priority over *bedfordi*, would necessarily be applied to it, provided the type locality actually is Kirghis-Nor.

For the present, I see no choice but to place *bedfordi* Matschie in the synonymy of *hemionus* Pallas. For the further elucidation of this question, there is great need of wild-killed material from the Kobdo region.

I readily agree with Schwarz (Zool. Garten, n. F., vol. 2, nos. 4–6, p. 92, 1929) in disposing of *Equus* (*Asinus*) *hemionus luteus* Matschie (in Futterer, Durch Asien, vol. 3, pt. 5, Zoologie (Nachtrag), p. 24, 1911) as another synonym of *hemionus* Pallas. The type locality is "in der Nähe des Surin-gol, zwischen Chami und Sut-schôu"; more exactly, it appears to lie 75–80 miles northwest of Surin-gol or Bulundsir River, along the route through the Gobi Desert between Hami and Suchow—at about lat. 41° 12′ N., long. 96° 8′ E.

The disposition suggested for the above-mentioned names leaves *Asinus hemionus hemionus* (Pallas) applicable to the wild asses of all Mongolia and perhaps of northern Chinese Turkestan as well.

Equus (Asinus) hemionus finschi Matschie

The proper name of the Transcaspian wild ass has long been a matter of uncertainty. This animal has generally been regarded as identical with the Mongolian *Asinus hemionus hemionus* (Pallas), but has been distinguished by Matschie and by Schwarz.

Matschie (in Futterer, Durch Asien, vol. 3, pt. 5, Zoologie (Nachtrag), p. 24, 1911) proposes *Equus* (*Asinus*) *hemionus finschi* on the basis of two specimens from the Zaisan Nor region in the former Province of Semipalatinsk. The type locality is "nordöstlich vom Saisan-nor." This subspecies is briefly characterized as reddish salmon, with a slight tinge of gray; the lips are white; the whitish of the under parts extends well up on the flanks; the dark vertebral stripe continues on to the base of the tail.

Lydekker (Cat. Ungulate Mammals Brit. Mus., vol. 5, p. 11, 1916) overlooks Matschie's paper.

Schwarz (Zool. Garten, n. F., vol. 2, nos. 4–6, p. 91, 1929) considers *Equus* (*Asinus*) *hemionus bedfordi* Matschie synonymous with *finschi*, and chooses *bedfordi*, on the basis of page priority, as the valid name of the Transcaspian wild ass. However, this action was evidently taken under misapprehension as to the type locality of *bedfordi*, which I prefer to regard for the present as a synonym of *A. h. hemionus* (Pallas).

If the Transcaspian animal is to be distinguished from the Mongolian subspecies on the one hand, and from the Persian subspecies on the other hand—and this seems quite reasonable from zoögeographical considerations—it should evidently be known as *Asinus hemionus finschi* (Matschie).

Equus onager Boddaert

Equus onager, as the name of the North Persian wild ass, has been commonly cited as from Pallas (Acta Acad. Sci. Imper. Petropolitanae 1777, pt. 2, pp. 258–277, pls. 11–12, 1780). Unfortunately, no such binominal name occurs in this or other works of Pallas, who used "Onager" only as a common name. Lydekker (Cat. Ungulate Mammals Brit. Mus., vol. 5, p. 12, 1916) ascribes the use of *E. onager* also to "Schreber,

Säugthiere, pl. ccciii, 1778." This use, if valid, would antedate Pallas. But Schreber's plate (CCCXII, not CCCIII) is labeled "*Equus Asinus* Linn.," followed on the line below by "Onager," which may be regarded as a common name. Sherborn (Index Animalium 1758–1800, p. 694, 1902), Matschie (in Futterer, Durch Asien, vol. 3, pt. 5, Zoologie (Nachtrag), p. 19, 1911), and Antonius (Proc. Zool. Soc. London 1937, vol. 107, ser. B, pt. 4, p. 559, 1938) ascribe *E. onager* to Zimmermann (Geogr. Gesch. Menschen, vol. 2, p. 80, 1780), but Zimmermann merely cites a polynomial from Brisson.

Apparently the next name to be considered is "*Asinus ferus* sive Onager auctorum," employed by Hablizl (Neue Nord. Beyträge, vol. 4, p. 88, 1783). Schwarz (Zool. Garten, n. F., vol. 2, nos. 4–6, p. 90, 1929) evidently does not consider this a technical name; and perhaps we may best dispose of it as merely a Latin descriptive term from the ancient authors. (Other names in Hablizl's paper, that are genuinely new, are labeled "m." (=mihi).) Hablizl's description is of two living captives, male and female, from Kasbin, northwestern Persia—the same specimens that had been described by Pallas (as Onager) in 1780.

Boddaert's description of his [*Equus*] *Onager* (Elenchus Animalium, p. 160, (1784) 1785) is apparently not completely diagnostic, but his references are: "Pall[as]. *neue Nord. Beitr.* II. p. 22. tab. 2. *Ane Sauvage. Wild Ass or Koulan.* Penn[ant]. *quadr.* p. 8. n. 3." Pallas's description and plate represent the animal from Kasbin, northwestern Persia. Pennant took his description from Pallas; he also mentioned Kasbin as one of the localities in the wide range of the wild ass, but he did not include Mongolia or Siberia. The range assigned by Boddaert ("Habitat in desertis Argunis") is therefore erroneous; the Argun steppes near Tarei Nor, on the Siberian-Mongolian boundary, constitute the type locality of *Equus hemionus* Pallas (1775). Hablizl wrote (1783, p. 93) that the particular habitat of the wild ass or onager is the mountains about Kasbin; this may be regarded as the corrected type locality of *Equus onager* Boddaert. The current name of the North Persian wild ass will stand as *Asinus hemionus onager* (Boddaert), as Schwarz (1929, p. 90) has already pointed out.

Asinus onager Hamilton Smith (Jardine's Naturalist's Library, vol. 20, Mammalia, Horses, p. 307, pl. 18, 1841) is doubtless a synonym as well as a homonym.

Asinus hamar Hamilton Smith

More than a hundred years ago Sir Robert Ker Porter made an unsuccessful chase after a wild ass in the northern part of the Province of Fars, Persia, between Yezdikhast and Shulgastan. He described the animal thus (Travels in Georgia, Persia, Armenia, Ancient Babylonia, etc., vol. 1, pp. 459–460, 1821):

"He appeared to me to be about ten or twelve hands high; the skin smooth, like a deer's, and of a reddish colour; the belly and hinder parts partaking of a silvery grey; his neck was finer than that of a common ass, being longer, and bending like a stag's, and his long legs beautifully slender; the head and ears seemed large in proportion to the gracefulness of these forms. . . . The mane was short and black, as was also a tuft which terminated his tail. No line whatever ran along his back, or crossed his shoulders, as are seen in the tame species with us."

A few days later, along his route to Shiraz, Porter (1821, p. 461) killed a specimen, and from it completed his sketch, which he reproduced as plate 11. He applied no technical name to the animal.

In 1841 Hamilton Smith (Jardine's Naturalist's Library, vol. 20, Mammalia, Horses, p. 351, pl. 19) based the name *Asinus hamar* on Porter's description and plate. This name appears on Hamilton Smith's plate 19 (which is obviously a copy of Porter's plate 11), but not in the near-by text (pp. 311–314), which is rather vague as to both characters and range. He states that the Hamar "was first figured by Sir R. Kerr Porter," but also mentions Northern Africa, Arabia, and Mesopotamia as apparently

parts of its range. The plate bears the notation "native of Africa," but so does the next plate (20) of *Asinus hemionus*, which is referred to in the text only as an Asiatic form. In a "Synopsis of the Equidae" at the end of the volume (p. 351), *A. hamar* is listed as "The Wild Ass of Persia."

From the foregoing it is safe to conclude that the type locality is where Porter first met with the animal, in the northern part of Fars, between Yezdikhast and Shulgastan. If George (Ann. Sci. Nat., ser. 5, zool., vol. 12, p. 34, 1869) purports to quote from Porter, he is mistaken as to the locality when he states that the animal lives in troops in the deserts of the Province of Fars, between Shiraz and the Persian Gulf.

Apparently no later specimen of an Asiatic wild ass has turned up, corresponding satisfactorily with Porter's description and plate, especially in the absence of a dorsal stripe. In this connection it is significant that St. John, who was familiar with the wild ass in the very part of Persia where Porter met with it, says (in Blanford, Eastern Persia, p. 85, 1876): "All of twenty or more specimens that I have seen from Western Persia were undoubtedly *E[quus] onager*." Perhaps Porter's description was erroneous in the matter of the dorsal stripe, or perhaps it was based upon an individual variation.

Lydekker (Cat. Ungulate Mammals Brit. Mus., vol. 5, p. 14, 1916) places *hamar* in the synonymy of *Equus hemippus* I. Geoffroy-Saint-Hilaire (1856), of the Syrian Desert. According to the available descriptions and figures, *hamar* probably resembles *hemippus* more closely than it does any other known form of this group. In this connection it may be recalled that Porter (1821, p. 460) refers to his animal as differing "in nothing" from that of the lower Tigris-Euphrates Basin. If, however, the two names should prove to be synonymous, *hamar*, with fifteen years' priority over *hemippus*, would be the valid one.

On the other hand, Schwarz (Zool. Garten, n. F., vol. 2, pp. 88, 94, 1929) places *hamar* in the synonymy of *Equus khur* Lesson (1827), of India.

Until topotypes of *Asinus hamar* can be secured and examined, it seems impossible to make any satisfactory disposition of the name. It is somewhat doubtful, however, if any wild asses remain at the type locality.

Asinus taeniopus Heuglin

This name was proposed by Heuglin (Petermann's Mittheilungen 1861, no. 1, pp. 15, 19, 1861) on the basis of a living animal, of no more exact provenance than the Red Sea. Thus there is an inevitable suspicion as to possible semidomestication or hybridization. There is apparently no evidence that the type was preserved. Lydekker (Cat. Ungulate Mammals Brit. Mus., vol. 5, p. 38, 1916), in recognizing it under the subspecific name of *Equus asinus taeniopus*, attempts, for some unexplained reason, to designate the "Hawash district of Abyssinia" as the type locality. On the other hand, Neumann (Zeitschr. f. Säugetierkunde, vol. 10, pp. 152–153, 1935) suggests the region south of Zeyla, British Somaliland, whence he records a specimen agreeing in some particulars with Heuglin's description. At the same time Neumann grants that there is frequent crossbreeding between wild stallions and female domestic asses. More than half a century ago Menges (Petermanns Mitteilungen, vol. 31, no. 12, p. 455, 1885) expressed the opinion that the animals exhibited in Europe as "*Equus taeniopus*" were crosses between wild asses and domestic asses.

"Heuglin. . .gives as type of his '*Asinus taeniopus*' a plate of a totally different ass [from *A. asinus somaliensis* Noack], showing an extraordinarily broad and long black shoulder-stripe, very strongly marked limbs, and a yellow ground-colour such as I have never seen in an ass of African origin. For me there can be no doubt that that plate was the work of an incompetent painter from the description of an inexact recol-

lection, and therefore by no means of scientific value. Owing to that the 'Heuglin's wild asses,' shown in many Zoos. . .are very doubtful beasts, at the utmost of feral, but certainly not of true, wild origin." (Antonius, Proc. Zool. Soc. London 1937, vol. 107, ser. B, pt. 4, p. 561, 1938.)

Under all these circumstances it seems best to regard the name *taeniopus* as indeterminable. Matschie proposed to discard it as long ago as 1894 (Zool. Garten, vol. 35, no. 3, p. 73, footnote).

For the present, therefore, the wild asses of eastern Ethiopia and southern Eritraea may be included at least provisionally with those of British Somaliland under the name of *Asinus asinus somaliensis* Noack.

Incidentally, the original reference for the latter subspecies is *A[sinus] taeniopus* var. *Somaliensis* Noack, Zool. Garten, vol. 25, no. 4, p. 101, 1884. Allen (Bull. Mus. Comp. Zool., vol. 83, p. 563, 1939) is in error in citing *somaliensis* from a later source and in considering it a *nomen nudum*.

RHINOCEROTIDAE

Rhinoceros lasiotis Buckland

The name *Rhinoceros lasiotis* is currently credited to P. L. Sclater (Proc. Zool. Soc. London 1872, p. 493, pl. 23, November, 1872). There appear, however, to be at least two earlier and valid uses of this name by Sclater (Nature, vol. 6, p. 519, October 24, 1872; Ann. Mag. Nat. Hist., ser. 4, vol. 10, p. 299, October, 1872). At the meeting of the Zoological Society on March 19, 1872, he had announced the arrival of the living animal, but had not bestowed the name *lasiotis* upon it at that time; this name was inserted in the published account of the meeting, which did not appear till November, 1872. In the meantime, "in a communication made to Section D of the British Association at Brighton on the 16th of August. . .I. . .proposed to call it *Rhinoceros lasiotis*" (Sclater, Proc. Zool. Soc. London 1872, p. 790, 1873). To this Sclater adds in a footnote: "See 'Times' of August 19, p. 5; and 'Athenaeum,' August 24, p. 243; also 'Nature,' October 24, p. 518."

Prior to the appearance in print of Sclater's own use of *lasiotis*, Frank Buckland described in "Land and Water" for August 10, 1872, under the name of *R. sumatrensis*, a hairy rhinoceros from "Malacca"—evidently the one that became the type of *Ceratorhinus niger* J. E. Gray (1873). He then adds the following paragraph:

"It will be remembered that I described another hairy rhinoceros sometime since, but it appears that this arrival is the true hairy rhinoceros. The other beast, which comes from Chittagong, therefore, is a new species, hitherto unknown and undescribed. It has been named by Dr. Sclater *Rhinoceros lasiotis*, or the hairy-eared rhinoceros. It has a tuft of hair like a curtain fringe round the edge of each ear. The hair on the body of this animal is like the hair on a baby's head, whereas the hair on the last arrival is stiff like a hedge hog's bristles."

The above appears to be unquestionably the original reference for *Rhinoceros lasiotis*. Since Sclater is evidently not responsible for the accompanying reference and description, Buckland must, it seems (under Article 21 of the International Rules), be credited with the authorship. The original reference may then be cited as: *Rhinoceros lasiotis* Buckland, Land and Water, August 10, 1872. In current usage the name will stand as *Dicerorhinus sumatrensis lasiotis* (Buckland).

The type locality is not exactly the town of Chittagong, Bengal, as might be inferred from Lydekker (Cat. Ungulate Mammals Brit. Mus., vol. 5, p. 51, 1916). The type specimen was captured south of Chittagong, at a distance from that point marched by elephants in about 16 hours (Sclater, Proc. Zool. Soc. London 1872, p. 493, 1872).

CAMELIDAE

Camelus bactrianus ferus Przewalski

This name for the wild Bactrian camel was employed first in the original Russian edition of Przewalski's "Third Journey into Central Asia" (p. 43, pl. facing p. 42, 1883). The author specifies no type locality, but gives the range (p. 44) as "from Tarim, Lob-nor, and Hami to southern Dzungaria; from Guchen and Manas to northwestern Zaidam, Tibet." He refers here to his previous description of several specimens (From Kulja, across the Tian Shan to Lob-nor, pp. 93–94 of the English edition, 1879). Three of these specimens were from "the border of the Kum-tagh"; the fourth was from "the lower Tarim." Accordingly I suggest, as the restricted type locality, the border of the Kum-tagh, east of Lob-nor and north of the Altyn-tagh, Chinese Turkestan.

MOSCHIDAE

Moschus moschiferus Linnaeus

The type locality of *Moschus moschiferus* Linnaeus (Syst. Nat., ed. 10, vol. 1, p. 66, 1758) is "Tataria versus Chinam." According to G. M. Allen (Amer. Mus. Novit., no. 430, p. 8, 1930), "Linnaeus refers only to Ray, whose account is a transcription of that by Grew of a specimen then in the museum of the Royal Society of London." As a matter of fact, Linnaeus gives several other references, but none of them seem to furnish any clear information tending to fix the type locality.

The range of the typical subspecies is given by Flerov (C. R. Acad. Sci. URSS, 1928 A, no. 24, p. 515, 1929) as "mountains of Western and Central Siberia." Allen remarks (1930, p. 7) that the locality mentioned by Linnaeus is a most indefinite one, "but perhaps to be interpreted somewhat as Flerov has done." He adds (pp. 7–8): "The first musk deer to reach Europe was perhaps the one mentioned by Marco Polo. . . .He mentions it as abundant in the Altai and northern Chinese country, especially about Si-fan." On this clue, I venture to propose the Russian Altai as the restricted type locality of *moschiferus*.

In a general account of musk deer preceding his "Descriptio *Moschi sibirici*," Pallas (Spicil. Zool., fasc. 13, pp. 14–16, 1779) gives the general Asiatic range of these animals. However, in the particular account of *Moschus sibiricus* (which is introduced on p. 29 of the work just cited), the only locality that Pallas seems to mention (1779, p. 32) is "above Abakan," one of the upper tributaries of the Yenisei. Accordingly it seems quite necessary to consider this the type locality; and thus *sibiricus* doubtless becomes a synonym of *moschiferus*.

In view of the foregoing, Flerov's proposal (1929, p. 516) to restrict the type locality of *sibiricus* to "Eastern Siberia" must be considered invalid. Since Allen (1930, p. 7) regards the differences between eastern and western Siberian specimens as "unimportant," the name *moschiferus* may be applied, for the present at least, to the animals of both regions.

The last statement is not intended to affect the status of *Moschus moschiferus arcticus* Flerov (1929, p. 516; type locality, Mount Toulaja, 460 km. north of Verkhoyansk, Siberia).

CERVIDAE

Cervus maral var. **songarica** Severtzov

The Tian Shan wapiti was originally described as [*Cervus maral*] var. *songarica* by Severtzov (Izviestiia Imper. Obshchestvo Liub. Estest., Antrop. Etnogr. Moscow, vol. 8, pt. 2, p. 109, 1873; English translation in Ann. Mag. Nat. Hist., ser. 4, vol. 8, p. 386, 1876). It is currently known as *Cervus canadensis songaricus*. The three male specimens, on which Severtzov's description was chiefly based, were obtained in the

Za-ilisky (Transilian) Alatau, east of Vyernyi, on the summits of Turgeni, near the eastern portion of Issik-kul, Semiretchie, Russian Turkestan (Severtzov, 1873, p. 103; 1876, p. 377). A fourth specimen (a female) was obtained in the fir-woods of Shamsi in the Alexandrovsk Mountains. Obviously the type locality, if restricted, must be one of the two localities just mentioned, and the first one is here selected. Lydekker (Cat. Ungulate Mammals Brit. Mus., vol. 4, p. 136, 1915) is clearly in error in attempting to designate as type locality "the Zungarian Tien-Shan, probably in the neighbourhood of Kulja."

[To be continued.]

American Committee for International Wild Life Protection, Philadelphia, Pa.

A NEW MOLE FROM ANNAM

By Gerrit S. Miller, Jr.

A mole collected in Annam by Mr. E. Poilane of the "Institut des Recherches Agronomiques de l'Indochine" represents a species related to the Siamese *Talpa klossi* Thomas, the Chinese *T. longirostris* A. Milne-Edwards and the Indian *T. micrura* Hodgson, but obviously distinct from all of these animals. I propose to describe it as:

Talpa parvidens sp. nov.

Type specimen.—Adult female in alcohol (skull removed) no. 258342, United States National Museum. Collected in forest at the agricultural station of Blao, "Délégation de Djynrinh", near the upper Donai River, Annam, French Indo China, June 13, 1933, by E. Poilane.

Specific characters.—A member of the group of southeastern Asiatic species of *Talpa* characterized, as compared with *T. europaea*, by slenderness of rostrum, and somewhat laterally opening nostrils. Differs from *Talpa micrura* Hodgson and *T. klossi* Thomas in its more slender skull and noticeably smaller cheekteeth, from *T. longirostris* in its much shorter tail.

External features.—Apparently the external form differs little from that of the related species. Tail about as well developed as in *Talpa klossi* (therefore considerably larger than in *T. micrura* but much smaller than in *T. longirostris*, the tail of which resembles the tail of *T. europaea*); longest tail hairs (10 mm) slightly exceeding length of tail itself (8 mm). Muzzle (as in *T. klossi*, *T. micrura* and *T. longirostris*) more elongated than in *Talpa europaea*, the nostrils opening somewhat laterally instead of directly forward.

Skull.—The skull is distinguishable from skulls of *Talpa klossi* and *T. micrura* by its general slenderness, in particular by the slenderness of the portion that lies in front of the coronal suture, when viewed from above, and by the narrowness of the palate when viewed from below. Ratio of palatal breadth to palatal length 52.9 as compared with 65.8 in *Talpa klossi* (no. 256898 U. S. N. M.) and 65.2 in *T. micrura* (no. 260741) respectively.

Teeth.—Relatively to the size of the skull the cheekteeth of the Annam mole are distinctly smaller than those of *Talpa klossi* and *T. micrura;* pm^2 and pm^3 single rooted; pm^4 with a well-developed anterior cingulum cusp (absent in *Talpa klossi* no. 256898 U. S. N. M., and *T. micrura* no. 260741; usually absent or poorly developed in *Talpa europaea* and its allies). As compared with the teeth of *Talpa longirostris* from Szech-

uan, China, the upper molars of *T. parvidens* are distinguished by their smaller size and by the less obliquity of the median crown line to the median line of the palate.

Measurements—Head and body, 140 mm; tail, 6; longest hairs of tail, 10; hind foot, 18 (without claws, 14.4); fore foot, 19 (without claws, 14); length of muzzle beyond incisors, 8; width of rhinarium, 3. Skull, greatest length, 34.0, condylobasal length, 33.6; breadth of braincase, 14.7; interorbital constriction, 6.5; palatal length to anterior border of alveoli, 13.4; greatest palatal breadth across anterior molars, 7.2; upper toothrow (alveoli), 13.0; mandible, 21.0; mandibular toothrow (alveoli), 11.0.

Remarks.—The characteristics of the Annamese mole resemble those of the Siamese *Talpa klossi* more nearly than they resemble those of the other described southeastern Asiatic species. Its slender skull, small cheekteeth and the form of its fourth upper premolar readily distinguish the animal from the other members of the group of species to which it belongs.

On the label accompanying this specimen Mr. Poilane wrote as follows (my translation):

"A mole found dead and almost rotten in the forest. I found it thanks to the bad smell that it gave out. This animal is very rare; during 14 years that I have traveled about in this country this is the second that I have found. The first was near Pakho on the frontier of China; but the one I am sending is probably the first found so far down toward the south. The locality was at 800 meters altitude, in red basaltic soil, near a small stream whose bed and the valley in which it flows are bestrewn with red basalt rocks. Annam Agricultural Station of Blao, Délégation of Djyrinh, near to the Haut Donal, June 13, 1933".

Division of Mammals, United States National Museum, Washington, D. C.

A NEW THOMOMYS FROM TEXAS

By William B. Davis

Additional specimens of *Thomomys bottae* from trans-Pecos Texas in the Texas Cooperative Wildlife Collection reveal the presence of an apparently unnamed pocket gopher in the Sierra Diablos, a range of isolated mountains in Culberson and Hudspeth counties just to the south of the Guadalupe Mountains. For this race I propose the name

Thomomys bottae scotophilus, subsp. nov.

Sierra Diablo Pocket Gopher

Type.—Female adult, skin and skull, no. 682, Texas Cooperative Wildlife Collection; one and one-half miles west of Bat Cave, Sierra Diablo, Hudspeth County, Texas; collected August 27, 1938, by William B. Davis; original no. 3220.

Distribution.—Apparently restricted to the higher parts of the Sierra Diablo range in Culberson and Hudspeth counties.

Diagnosis.—Size small (see measurements). Color of upperparts fulvous, the median dorsal area suffused with blackish brown; underparts plumbeous, with tips of hairs washed with fulvous; upper surface of feet and lining of cheek pouches white; postauricular patches, lateral lips, and chin, black. Skull comparatively smooth and, relative to mastoidal breadth, shallow.

Comparisons.—Compared with *Thomomys baileyi* from Sierra Blanca, some 20 miles to the west: Color similar, but hind foot smaller (27 mm. as opposed to 30 mm.); skull smaller and with incisors less protruding. Compared with *T. bottae texensis* from the Davis Mountains, some 50 miles to the southeast: Much lighter in color; posterior extension of premaxillary processes 50 per cent shorter; auditory bullae averaging larger. Compared with *T. bottae guadalupensis* from the Guadalupe Mountains, some 50 miles to the north: Lighter in color; skulls of comparable age smaller and, relative to mastoidal breadth, shallower (ratio of palato-frontal depth to mastoidal breadth 73 as opposed to 79).

Measurements (females only available).—Averages and extremes, in millimeters, of four adults: Total length, 195 (186–202); length of tail, 55 (53–56); length of hind foot, 27 (26–28); basilar length of Hensel, 28.7 (27.6–30.1); zygomatic breadth, 20.8 (19.9–22.7); mastoidal breadth, 17.4 (16.6–18.1); length of nasals, 11.6 (10.9–12.6); breadth of rostrum, 7.0 (6.6–7.8); alveolar length of maxillary tooth row, 7.2 (7.0–7.4); palato-frontal depth, 12.7 (12.3–13.6).

Remarks.—Of the kinds of *Thomomys* occurring in Texas, *T. bottae scotophilus* is most closely related to *T. b. guadalupensis*, yet, probably in response to its complete isolation, the population of pocket gophers in the Sierra Diablos is noticeably different from that in the Guadalupe Mountains. It seems probable that at some earlier time, perhaps late in the Pleistocene, *T. b. guadalupensis*, *T. b. texensis*, and *T. b. scotophilus* occupied a more or less continuous range. Subsequent isolation of populations, effected by climatic and physiographic changes, doubtless made possible the differentiation now existing.

The valleys around the Sierra Diablo and Guadalupe Mountains are occupied by another genus of pocket gophers, *Cratogeomys*. These gophers apparently have excluded *Thomomys* from the lowlands. At any rate, I failed to capture a single specimen of *Thomomys* in the lowlands. The opposite situation does not hold, however. At Bat Cave, approximately 6,000 feet elevation, in the Sierra Diablos I captured a young *Cratogeomys* in the same area where most of the *Thomomys* were secured. That *Cratogeomys* is not more abundant near Bat Cave is probably due to the shallow, rocky nature of the soil. I infer that such large-bodied burrowing rodents as adult *Cratogeomys* cannot succeed in the extremely rocky, thin soils to which *Thomomys* appears to be restricted in this area.

At Pine Spring, situated at the southeast base of the Guadalupe Mountains, I found the ranges of *Thomomys* and *Cratogeomys* meeting at an elevation of approximately 6,000 feet. Above that elevation *Cratogeomys* was absent entirely. Again, the line of demarcation correlated well with the nature of the soil, *Cratogeomys* being restricted to the deep, relatively rockless soils.

In the valley between the Sierra Diablo and Sierra Blanca ranges trapping revealed the presence only of *Cratogeomys*, thus apparently removing any possibility of the intermingling of *Thomomys baileyi* and *T. bottae scotophilus*. This situation prevails southeast of the Sierra Diablo also; the lowlands are occupied by *Cratogeomys*.

Specimens examined.—Six, all from Hudspeth County, as follows: 1.5 mi. W. Bat Cave, 1; Bat Cave, 5.

Texas Cooperative Wildlife Research Unit, College Station, Texas.

STATUS AND AFFINITIES OF THE BEARS OF NORTHEASTERN ASIA

By Ernst Schwarz

The latest comprehensive revisions of the bears of northeastern Asia are those of Ognev (1931) and Pocock (1932). As the results of these two authors differ considerably I have attempted, with the material available in the United States National Museum, to straighten out these differences. I have also tried to define the affinities of these bears in their relationship to the group of brown bears inhabiting the Palaearctic region.

The material at hand includes (1) twenty-nine skulls, from the neighborhood of Petropavlovsk, East Kamchatka, collected by L. Stejneger in 1882–1883 and two skins in Dr. Stejneger's private possession; (2) one skull and skin from twenty miles north of I-mien-po, near Ninguta, Kirin Province, Manchuria (U. S. N. M. No. 199683, young adult male, collected by A. de C. Sowerby in 1914); (3) two skulls and skins from Kultuk, west of Lake Baikal, central Siberia, collected by G. Mixter in 1912; (4) two skulls from the Great and Little Annui rivers, respectively, east of the Kolyma River, Arctic slope, northeastern Siberia, collected by C. Amory, Jr., in 1914; (5) two skulls from Hokkaido Island, North Japan, obtained from Professor S. Mozawa in 1898.

It appears that every one of these five groups of specimens is representative of a separate form of brown bear. The largest animal among them is the Kamchatka giant bear. The series before me is remarkably uniform, and all of the skulls are of the high-browed type; they have enormous frontal sinuses that raise the forehead strongly above the level of the face. The same is true of the Manchurian skull, which I cannot distinguish from the Kamchatka series. Pocock has already come to the conclusion that the bears from these two regions have the same type of skull. The two skulls from Hokkaido have the same general style, but they are not so large, although still of the giant type; they have narrower teeth. The skulls from the Arctic slope are very much smaller, with weak canine teeth. One is low-browed, the other is high-browed. The two skulls from Lake Baikal are also of the smaller type, and are somewhat intermediate between the high-browed and the low-browed types.

As a result we find that the big bears of the Pacific Coast and islands are all of the high-browed type, whereas farther west both the high- and low-browed types occur in a single population.

On the other hand, it can be shown that various color mutants occur in one and the same population. I have before me the two skins from Kultuk, west of Lake Baikal. One of them is pale brown, the other very dark, almost blackish-brown, each with a wash of buff or creamy. Pocock has described

the same phenomenon in the Himalayan bear (*Ursus isabellinus* Horsfield) where even more than one mutant is known. The same type of variation is not uncommon in European bears. These variations are in no way linked with variations in the skulls.

If these facts be borne in mind, it becomes clear that the two forms of bear that Sowerby has described from Manchuria and the Primorsk Province of east Siberia, his black bear (grizzly), "*Spelaeus cavifrons*," and his "brown bear," "*Ursus mandchuricus*" are mutants of one animal. There is no proof at all that the black mutant is linked with the high-browed skull and the brown mutant with the low-browed skull. On the contrary, Lönnberg (1923) has described a specimen from north Mongolia which has the skin black combined with a low-browed skull.

It appears, therefore, that we have in Manchuria only one species of true *Ursus*; the specific names *lasiotus* Gray (1867), *mandchuricus* Heude (1898), and *cavifrons* Heude (1898) clearly apply to it. This is a bear of giant size with a variable skull, and with the color brown or blackish. The total length of the skull of the old male, as indicated by the measurements published by Lönnberg, Ognev, and Pocock (8 skulls) varies between 387 and 455 mm.

The bears from Kamchatka are also of the giant type. From the data published by Middendorff (1853, p. 4), Ognev (1931, p. 149), and from the large series in the U. S. National Museum, it is, however, apparent that this whole population has the high-browed type of skull. There is a certain amount of variation in color from snuff-brown to deep bister, always with a more or less pronounced wash of buff; but there is no record of any skin that was deep blackish-brown as in the dark mutant of the Manchurian bear. The variations in size of the skull of the old male (computed from Rowland Ward's records, 1910, p. 512, Ognev, 1931, p. 151, and the material before me) is between 390 and 482, with an average of 411.6, which is very similar to that found in the Manchurian population. With more Manchurian material the size of the two animals would probably be found to be about the same. Altogether, I cannot see any relevant difference to distinguish the high-browed type of skull of the Manchurian bear from the average skull from Kamchatka. But the two populations are clearly distinct, the Manchurian population varying in color and in the shape of the skull, whereas the variation in color of the Kamchatkan population is restricted and that of the skull is very limited in extent.

Two names have been used for the Kamchatkan bear, viz.: *Ursus beringianus* Middendorff (1853), and *U. piscator* Pucheran (1855).

Ursus arctos var. *beringiana* Middendorff was described from Shantar Island, southwest Okhotsk Sea. No definite record appears to be available of the color of the bears from this island. Because Manchurian and Kamchatkan skulls show the same average type, the Shantar skulls cannot be used to settle the status of the name. All the evidence available, however, con-

cerning the fauna of the Shantar Islands links the mammals living there with the Manchurian mainland and not with the Kamchatkan Peninsula. Both the tiger (*Panthera tigris longipilis* Fitzinger) and the Manchurian spotted deer (*Sika nippon mantchuricus* Swinhoe) are known to occur. For many years the Berlin Zoo had a breeding couple of "Siberian" tigers, and a considerable stock of the large-spotted Manchurian sika. Both were imported from Great Shantar Island. I shall, therefore, use the name *Ursus beringianus* Middendorff for the Manchurian bear and *U. piscator* Pucheran for the Kamchatkan bear.

As regards the Hokkaido bear, Pocock (1932, p. 794) united it with the "black manchurian Bear," which he called *lasiotus*. Sowerby, following Heude, admits a brown bear (*Ursus yesoensis*), and a black bear (*Spelaeus melanarctos*).

Pocock appears to have believed that the brown individuals are young and the black individuals are adult. On the contrary it appears likely that on Hokkaido there is a considerable range of variation in color from pale brown to almost black (Pocock 1932). The Berlin Zoo had a male from Hokkaido which was very dark brown, heavily washed with creamy on the back. A good photograph of this animal has been published by Heck (1899). I have before me two immature skulls from Hokkaido. When compared with skulls of the same age from Kamchatka, they are seen to be considerably smaller, and with narrower cheek teeth. The Hokkaido bear obviously represents a distinct race for which the name *Ursus yesoensis* Lydekker (1897, p. 422) must be used. From the measurements published by Ognev (1931) of the bear from the island of Sakhalin, it appears highly probable that this animal is the same as the Hokkaido form.

The bear of the extreme northeastern end of Siberia, particularly the Arctic coast, has been regarded as distinct from the Kamchatkan bears by Ognev (1931, p. 85), and described as *Ursus arctos kolymensis*. Pocock, on the contrary, regards *kolymensis* as a synonym of *Ursus beringianus*. The two skulls from the Great and Little Annui rivers, however, indicate a bear of normal size, closely related to, but apparently slightly smaller than, the bear from Lake Baikal, i.e., a bear of the general type common to all the brown bears of Europe and the greater part of Siberia. Ognev was fully aware of this fact when he included this form in his *Ursus arctos* type. The range of this form, and the region where it meets the giant bear of Kamchatka, remain to be established. The animal is known to occur in the area along the Arctic slope from the Kolyma River, as far east as the Anadyr River. The measurements of the skulls of two old males from the lower Anadyr River published by Ognev (1931, p. 149) are 334 mm. and 366 mm. total length. This is clearly within the range of variation of the normal *arctos* type, i.e. of *kolymensis*.

On the other hand Ognev (1931, p. 151) records a bear of the giant Kamchatkan type, i.e., *Ursus piscator*, from Markova, Upper Anadyr River. Another record from a rather far northern locality was published by J. A. Allen (1903, p. 164). His animal came from Olyutorski Bay (= Baroness Korff Bay) on the coast north of the Kamchatkan Peninsula. It appears, therefore, not impossible that the ranges of the Siberian brown bear and the Kamchatkan giant bear overlap in this region.

The bear from St. Lawrence Island, Bering Sea, submitted to me for examination, and recorded by A. H. Howell in this number of the Journal, is referred to *kolymensis*.

The bears from Transbaikalia are referred to *Ursus lasiotus* by Pocock. They come under what Ognev calls *U. baikalensis*; but the small series described is not sufficient to show the exact relationships of this form to the European *Ursus arctos arctos*, and the Arctic bear *Ursus a. kolymensis*, except that it shows that *baikalensis* belongs to the brown (*arctos*), not the giant (*beringianus*) group of bears.

The same is true of the bears from west of Lake Baikal, of which the two specimens from Kultuk, near Irkutsk, are representative. They come, apparently, from the same general area as the form which Ognev calls *jeniseensis*. These skulls are decidedly larger than the two arctic skulls.

The occurrence of *Ursus isabellinus* in the Tian Shan range, as maintained by Pocock, appears to me at least not proved. The Berlin Zoo, for many years, had a very large male bear from Chuguchak, on the southern slope of the Tarbagatai range, in the northwest corner of Dzungaria. This animal was very pale reddish-brown with the ears thickly haired. When it arrived as a cub, it had the ears strongly tufted in the *isabellinus-pruinosus* style. I am inclined, for these reasons, to agree with Pocock that the Tian Shan bears are closely related to *Ursus isabellinus;* but they are obviously larger. I believe they should be separated as *U. leuconyx* Severtzov (1873).

A summary of the facts discussed in this paper appears to admit of four groups of recent forms of *Ursus* in the Old World. They are most conveniently regarded as full species: (1) *Ursus arctos* Linnaeus, *U. syriacus* Hemprich and Ehrenberg, *U. isabellinus* Horsfield, and *U. beringianus* Middendorff. In addition we have the Pleistocene species of Europe, *U. spelaeus* Rosenmüller.

The question of how many specific groups should be admitted in North America cannot be discussed in this connection. It must, however, be pointed out that both Middendorff (1853) and Merriam (1896, p. 66) were fully aware of the close relationships between the giant bears of northeastern Asia and those of northwestern North America. Careful study of the Kodiak bear leaves no doubt in my opinion that the difference between it and *Ursus beringianus beringianus* Middendorff is only subspecific.

SPECIFIC GROUPS OF URSUS IN THE OLD WORLD

Ursus arctos Linnaeus.—Originally included the greater part of Europe. In northern Asia typical brown bears are found in the forested country north of the central plateau. There are no bears in the Khirghiz Steppes. This means that the *syriacus* and *isabellinus* groups are separated from the range of *arctos* by dry country. From the Altai the range of *Ursus arctos* extends east into the forested low-lying and mountainous areas. It reaches the Arctic coast and Bering Sea, but does not, apparently, occur to the southward along the coast of the Okhotsk Sea. It is not known for certain where the ranges of *U. arctos* and *U. beringianus* meet east of Lake Baikal. But it appears very probable that they overlap in the Anadyr Valley in the extreme northeast.

Ursus isabellinus Horsfield.—Western Himalayas (subsp. *isabellinus* Horsfield); Hindukush (subsp. ?); Pamirs (*"pamirensis"* Ognev, status to be established; measurements are close to those of *leuconyx*); Tian Shan, Tarbagatai (Berlin Zoo; subsp. *leuconyx* Severtzov); Tibet, Kansu, Shensi (subsp. *pruinosus* Blyth). Range separated from those of *Ursus arctos* in the north and of *U. syriacus* in the west.

Ursus syriacus Hemprich and Ehrenberg.—Asia Minor, Armenia, Caucasus, mountains of Syria and northern Palestine.

Ursus beringianus Middendorff.—Forests of Manchuria, Primorski Province, ranging west beyond the great Khingan Mountains (recorded from Hailar by Sowerby 1923, p. 52); also Great and Little Shantar islands (*U. beringianus beringianus* Middendorff). A second subspecies, in Kamchatka, ranges north along the coast and into the Koriak country, the northernmost records being from Olyutorski Bay (Allen, 1903, p. 165), and Markova, Anadyr River (Ognev, 1931, p. 151, *U. beringianus piscator* Pucheran); range apparently overlapping with that of *Ursus arctos kolymensis* Ognev in the Anadyr Valley. The bear from Hokkaido, and probably from Sakhalin, will have to stand as *U. beringianus yesoensis* Lydekker.

Ursus spelaeus Rosenmüller.—This is the species of the European Pleistocene. It is a giant type. The skull is hardly distinguishable from those of the giant bears of the *Ursus beringianus* type (Miller 1920, p. 229). But this species is well characterized by the almost constant absence of the small anterior premolars. The wrinkled appearance of the molars, held to be characteristic by Ehrenberg (1931, p. 68), is also found in the Tibetan bear *Ursus isabellinus pruinosus* Blyth.

GREATEST LENGTH OF SKULL IN URSUS (IN MILLIMETERS)

Ursus arctos arctos Linnaeus.—According to Ognev (1831, pp. 140–142) bear skulls from European Russia have the following measurements: Males, min. 341, max. 387.3; females, min. 266, max. 335.6. Occasionally individuals of giant size are found. They are outside the normal range of variation. Ognev gives a length of 422 mm. for a skull from Novgorod.

Ursus arctos subsp. (*jeniseensis* Ognev ?).—Total length of skulls of two old males, nos. 175,687 and 175,688, U. S. Nat. Mus., from Kultuk, west of Lake Baikal, respectively: 347,370 mm. Ognev (1931, p. 147) gives the following as normal measurements of *U. a. jeniseensis:* Males, min. 352, max. 393 (giant 421); females, min. 380, max. 396.

Ursus arctos kolymensis Ognev.—Ognev's (1931, p. 149) measurements for adult skulls are: Males, min. 333.2, max. 375; females, 307.6 (1 skull). Three male skulls in U. S. National Museum from the Little Annui River (200,771, young adult), the Great Annui River (200,772, old) and St. Lawrence Island, Bering Sea, (265,076, old) have the total length as follows: 335,320.5, 368.

Ursus beringianus beringianus Middendorff.—Measurements of 8 male skulls computed from Ognev (1931, p. 151) and Pocock (1932, pp. 796–797) show the following range of variation: min. 387, max. 455.

Ursus beringianus piscator Pucheran.—The following range of variation for adult skulls is exhibited by combining the measurements of 29 skulls in the U. S. National Museum and those published by Rowland Ward (1910, p. 512), Ognev (1931, pp. 149–151), and Pocock (1932, pp. 796–797): Males, min. 390, max. 482; females, min. 319, max. 391. The measurement of a male, not fully grown skull, from Olyutorski Bay (Allen, 1903, p. 165) is 390; that of a male skull from Markova, Anadyr River (Ognev, 1931, p. 151) is 391.2

Ursus beringianus yesoensis Lydekker.—Measurements of a subadult male and a subadult, but slightly older female skull from Hokkaido in the U. S. National Museum (83,988 and 83,989) are as follows: (the measurements of the female skull are in parentheses): length of cheek-teeth series $p^4 - m^4$, 73.5 (67.5), width of m^2, 18.8 (17.3). Corresponding measurements of a male and female skull from Kamchatka (21,279 and 21,294) of comparable age are: 73 (67.9), 18.8 (17.3).

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Washington, D. C.

THE SYSTEMATIC STATUS OF THE LOUISIANA MUSKRAT

By William B. Davis and George H. Lowery, Jr.

When Bangs (Proc. Boston Soc. Nat. Hist., vol. 26, 1895, p. 541) described *Fiber zibethicus rivalicius* from the coastal marshes of Louisiana he considered it merely subspecifically distinct from the common muskrat of the northern part of the United States. Hollister (North Amer. Fauna, no. 32, 1911, p. 31), in his systematic synopsis of the muskrats, raised the Louisiana race to full specific rank, basing his reason for so doing, if we interpret his statements correctly, largely upon the supposition that the Louisiana muskrats were completely isolated. Because of this, he reasoned, there could be no interbreeding with the northern form, hence intergradation was impossible.

The present tendency among mammalian systematists is to use trinomials for those populations that exhibit differences of significant means of cranial and other measurements of taxonomic worth and to reserve binomials for those populations that exhibit trenchant differences. This, it seems to us, is the logical use for trinomial and binomial names. Were binomials to be used in every instance where an isolated population differs significantly in the means of characters, the concept of close relationship would be lost. The only excuse for the use of trinomials at all is to indicate that a population which differs only in the *average* of characters, even though completely isolated, is very closely related to neighboring populations and that no trenchant differences exist.

In identifying a number of muskrats from the coastal marshes of Texas, we found it necessary to examine specimens from near the type locality of *rivalicius*. Specimens were available also from Baton Rouge, Louisiana, some 100 miles north and west of the type locality. All of these specimens were compared with muskrats secured on loan from the Biological Survey from Wisconsin, Minnesota, and Michigan, with the following results. The cranial differences between *Ondatra z. zibethicus* and *O. z. rivalicius* are slight. The Louisiana and Texas muskrats average slightly smaller; the lateral border of the maxillary plate of the zygoma averages narrower in *rivalicius* and the nasals tend to be less expanded distally. We were unable to find a single constant difference except in the color of the pelage. The specimens from Texas are nearly black; those from near the type locality of *rivalicius* are somewhat paler. Baton Rouge specimens are heavily suffused with brown, which is lacking for the most part in the coastal muskrats; but they are darker than the northern-taken specimens.

Because of the obvious close affinity of *zibethicus* and *rivalicius*, the complete lack of trenchant cranial differences, and the fact that actual geographic intergradation between the two forms is shown by the specimens at Baton Rouge, it seems best to reduce *rivalicius* to its original status of subspecific rank.

Specimens to the number of 34 have been examined, as follows: *Louisiana:* Davant, Plaquemine Paris, 7; Baton Rouge and University, East Baton Rouge Parish, 14; New Orleans, Orleans Parish, 1; Grand Isle, Jefferson Parish, 1; Abbeville, Vermilion Parish, 2; Grand Chenier, Cameron Parish, 1. *Texas:* 2 mi. S.W. Pasadena, Harris County, 8.

Dr. W. A. Reed of the Louisiana State University faculty informs us that the generic name of the muskrat (*Ondatra*) is a French Canadian word of Iroquois Indian (= Huron) derivation and masculine in gender. (See also Sylva Clapin's "Dictionnaire Canadien-Français," Montreal and Boston, p. 362). Furthermore, Link, who introduced the term into zoological nomenclature, treated it as masculine. Miller's use of the word as a feminine noun (Bull. U. S. Natl. Mus., No. 79, p. 230, December 31, 1912) is therefore not justified.

Texas Cooperative Wildlife Research Unit, College Station, Texas, and Museum of Zoology, Louisiana State University, University, Louisiana.

GENERAL NOTES

REMARKS ON E. A. BOWLEY'S NOTE CONCERNING ALLEGED DELAYED FERTILIZATION IN DROMICIA

With reference to the very interesting note by Eileen A. Bowley on page 499 of the November, 1939, number of this Journal, I think the data suggest but by no means prove any extended sperm survival in the phalangerid *Dromicia*, since another interpretation is possible.

According to the data, a minimal gestation period of 51 days only is required if fertilization occurred on March 26, the day preceding the acquisition of the mother; for 23 days after the *suspected* date of delivery of the second litter of young these had attained a stage of development roughly equal to that of the first litter 28 days after arrival. Fifty-one days is a long span of gestation for a marsupial. Its assumption demands the additional assumption of a postpartum ovulation as seen in the rodents. The lengthened span may, however, have been correlated with lactation and due to *delayed implantation*. This phenomenon has been established for certain mammals; but the survival of sperms in the female tract for more than 2 days has been proved for no mammal, except in some bats in which the low body temperature during hibernation plays an important rôle.—Carl G. Hartman, *Baltimore, Maryland.*

ANOTHER HEAVY CONCENTRATION OF CRYPTOTIS IN TEXAS

Last year I reported in this Journal (vol. 19, no. 4, pp. 499–500) on a surprisingly high percentage of *Cryptotis parva* remains found in dejecta collected at the roost of a pair of barn owls in Colorado County, Texas. Data obtained from the examination of 25 barn owl pellets collected May 11, 1939, at Hog Island, Jefferson County, Texas, by Dan W. Lay, Regional Game Manager for the Texas Game, Fish and Oyster Commission, reveal a still larger percentage of these shrews. One hundred and two of 152 "kills" found in the pellets were of *Cryptotis parva*, indicating that more than 67 percent of the total number of food items captured by these owls were shrews. Only 9 of the 25 pellets lacked shrew remains, revealing that 64 percent of the meals eaten included one or more shrews. One pellet contained 20 *Cryptotis* and 4 other small mammals (*Reithrodontomys*, *Baiomys*, and *Oryzomys*).

SUMMARY OF THE ANALYSIS

Mammals		*Birds*		*Miscellaneous*	
Cryptotis	102	Redwing blackbirds	5	Beetle (sp. indet.)	1
Baiomys	14	Rail (clapper or king)	3	Grasses—incidental?	
Reithrodontomys	10	Sparrow (sp. indet.)	2	Weed seeds—from stomachs of birds?	
Sylvilagus (yg.)	7	Unidentified	1		
Sigmodon	5	Total	11		
Oryzomys	2				
Total	140				

Seemingly the population of *Cryptotis* on Hog Island at the time the owls cast the pellets here discussed was extremely high as compared with other small mammals.—WILLIAM B. DAVIS, *Department of Fish and Game, Agricultural and Mechanical College of Texas, College Station, Texas.*

ALBINO SHORT-TAILED SHREWS FROM CONNECTICUT

In recent issues of the Journal of Mammalogy, William J. Hamilton, Jr. (vol. 20, p 252, May, 1939) and Leo T. Murray (vol. 20, p. 501, November, 1939) added new records of albinism among soricids. It may be interesting to record that I trapped two white short-tailed shrews (*Blarina brevicauda*) two miles northwest of Rockville, Conn. One was caught on April 18, 1937. The fur was an unblemished white, but the animal had died in the trap and I was unable to determine the eye color. The other, a male, caught in the same location on April 19, 1937, had an entirely white coat and pink eyes. These specimens were not preserved.—P. R. SIME, *Soil Conservation Service, Lubbock, Texas.*

A LONG ISLAND HOARY BAT

On the afternoon of December 2, 1939 a hoary bat (*Lasiurus cinereus*) was found hanging on the porch of a cottage, facing the sea at Oak Island, Long Island, N. Y. and brought home to Garden City for observation (Kimball). The day was fair early, with heavy fog later, gentle northeast winds, temperature around 42°. How long the bat had been there is unknown; but presumably it had arrived within a few days and would have been noticed if it had been present a week earlier. There seems to be no other Long Island record for this species later than October (Murphy and Nichols, Brooklyn Mus. Sci. Bull., vol. 2, no. 1, pp. 12–15, 1913), though there are December records elsewhere in these latitudes. The bat was placed in a cage indoors. On December 3 it was active when handled, actually flying about the room; but on this day, a Sunday, no appropriate food was obtainable for it. A spider placed in its mouth was promptly spit out again. By the evening of December 4 it could hardly be induced to any activity, and a meal-worm, something known to be relished by a captive hoary bat (Murphy and Nichols, 1913), when placed in its mouth remained there, neither eaten nor ejected. The bat died that night, and when skinned for us and examined by H. C. Raven, was found to be a female in a very emaciated condition. It had an exceedingly large gall-bladder, good-sized liver, large pancreas and small spleen.

When found it hung motionless until taken in the hand; then it immediately started to 'chitter' and bite. At first it moved about the cage seeking to escape. It climbed mostly with its hind feet, moving backward, feeling for fresh holds when it hunched itself along the floor of the cage; it also used its mouth in climbing. It hung by both feet, or for long periods by one foot. On the floor of the room it hitched forward with the folded wings, and sometimes sprang into flight in this way. At other times, apparently attempting to take wing, it turned a back somersault on the floor. When hanging at rest it sometimes licked its fur with its long narrow tongue like a cat. It always sought

to hang by its hind feet. When so hanging, its tail was bent down over its abdomen, in which position the furred membrane no doubt helps keep the body warm. It was also noticed that in hanging positions the stiff tip of the tail was sometimes curved and used as an accessory in clinging. In the folded wing it was very noticeable that the wing-tip from the outermost digital joint was folded back.

On the afternoon of December 3 the bat's breathing when hanging asleep was timed by Mrs. Kimball for a little over an hour. Short periods with perceptible breathing alternated with much longer periods without. Breathing started slowly, increasing in speed, and becoming slow again, the last three or four breaths hardly perceptible. Observation started and ended with a breathing period, making 13 such in the time elapsed, with from 12 to 42 (average 32) breaths in each. The breathing periods were from 4½ to 6½ (average 5½) minutes apart, not counting one interval of 2¾ and another of 10¾ minutes. There was some correlation between the number of breaths and the

TABLE 1

TIME ELAPSED	BREATHS	INTERVAL FOLLOWING BREATHS
minutes		*minutes*
0	42	5½
5½	39	6¼
11¾	36	5½
17	37	6
23	32	5
28	12	2¾
30¾	27	5¾
36½	40	10¾
47	33	4¾
51¾	27	4¾
56½	28	5½
62	29	4½
66½	33	
	415	66½

ensuing interval. The smallest number, 12 breaths, was followed by the 2¾ minute interval, the 10¾ minute interval preceded by 40 breaths (table 1).

Certain conclusions bearing on the habits of the hoary bat may be drawn tentatively. This individual was presumably in migration at this late date, not disturbed from hibernation. The shore environment where it was found is one where migrating silvery-haired bats are frequent, and where migrant small birds occur in numbers, but where one would not expect a hoary bat to occur except as a migrant, or to remain. Also its death was apparently due to starvation, from physical activity (induced by disturbance and indoor temperatures) without food; but it seems unlikely that a bat with sufficient reserve to hibernate would have succumbed in so short a time. Migrant hoary bats no doubt sometimes freeze to death (Gregg, Jour. Mamm., 1937, p. 98) before reaching latitudes where they may obtain enough food to winter in a more or less active condition; but this individual if left undisturbed might well have completed a successful migration. On mild days in early winter there are plenty of moths and other insects on the wing. We have records of the red bat (*Lasiurus borealis*) at Mastic, Long Island flying at such times, evidently on its own initiative and not fortuitously forced from hibernation;

on December 26, 1936, mild with a gentle breeze, "a red bat flying in the early afternoon"; and on December 25, 1937, a mild, clear day, "a red bat flying back and forth in a sheltered place an hour before sunset" (Bird-Lore, 1937, p. 36, 1938, p. 33). There is every reason to suppose that the hoary bat is as hardy as the red bat (Kirk, Jour. Mamm., 1922, p. 185).—HEATHCOTE M. H. KIMBALL and JOHN T. NICHOLS, *Garden City, New York.*

BROWN BEAR KILLED ON ST. LAWRENCE ISLAND

In the Journal of Mammalogy for November, 1934 (pp. 316–317), Otto William Geist reported a brown bear seen on St. Lawrence Island in August, 1933, by Roland Snodgrass. The animal was shot at and possibly wounded, but escaped. Polar bears are said to be numerous in winter on the island, but brown bears have previously been unknown there. On May 20, 1939, this animal was killed near a reindeer fawning camp by Sepella, chief herder in the village of Savoonga. It was found to have reindeer meat in its stomach.

The skin, skull and skeleton were saved through the efforts of the Alaska Game Commission and forwarded to the U. S. Biological Survey, where the animal was identified as *Ursus arctos kolymensis*, a subspecies occurring in northeastern Siberia (see Schwarz's article in the present number, page 209).

St. Lawrence Island is about 37 miles distant from the Siberian coast at Cape Chibukak. It is assumed that this bear drifted across on the ice from Siberia.—ARTHUR H. HOWELL, *Biological Survey, U. S. Department of Interior, Washington, D. C.*

AN OTTER TAKES A RIDE

December 16, 1938 was a clear, cold day. At 3:20 p. m. I was walking upstream along the Kinderhook Creek in the town of Stephentown, Rensselaer County, New York, with the sun at my back. The creek was free of ice, full to the banks and running swiftly—about 4 miles per hour. Glancing upstream, I noticed a dark object floating down in midstream. As it came nearer, it resolved itself into an otter. I watched the animal come down through two riffles, with its head well up, body and tail held stiff and hind legs wide apart, very obviously enjoying a free ride. It skillfully avoided boulders and kept itself in the swiftest current. In quiet water and at a distance of 50 feet, it caught sight of me and dived, to reappear 50 yards downstream, where I lost sight of it in the glare of the descending sun.—DAVID B. COOK, *New York State Conservation Department, Albany, New York.*

NOTES ON THE WINTER ACTIVITY OF A CAPTIVE SKUNK

Recent investigations of the winter behavior of skunks, *Mephitis mephitis nigra*, by W. J. Hamilton, Jr. in New York (Ecology, vol. 18, pp. 326–327, April, 1937) and by D. L. Allen in Michigan (Journal of Wildlife Management, vol. 3, pp. 212–227, 1939) show considerable activity on the part of males and continuous hibernation by females.

During July, 1938, I obtained an orphaned male skunk about eight weeks of age on which hibernation notes were planned for the forthcoming winter at Ithaca, New York. It is recognized that the data obtained from one animal during one season can have little significance as compared with the extensive studies already cited; nonetheless the behavior was probably typical.

A backyard pen, 4 by 12 feet, with a surface nest box, quartered the animal during the summer. In late October I dug with pick and shovel a sizable den below the ground level within the pen. A burrow three feet long gave a slanting entrance to the chamber below ground, thus simulating a woodchuck den.

Daily observations incident to supplying the animal with food and water and the

placement of straws or sticks across the burrow entrance as indicators of activity (by their removal), established the date of the beginning of hibernation as November 23, 1938. Hibernation ended on February 23, 1939, when daily activity was resumed.

The data presented in the following table are largely corroborative of those published by Hamilton (1937). Low temperatures are evidently the exciting cause of winter sleep. However, this immature animal was unusually active, as Hamilton writes that young of the year "usually sleep throughout the winter, rarely venturing from their dens until mid-March." Quite possibly my animal may have been stimulated by the presence of food, which was supplied near the den whenever signs of activity were observed. "Activity" usually meant a sluggish exit from the den for observed periods of from five minutes to one hour, rarely more than one-half hour and mostly in late afternoon or early evening. Hibernation totaled 64 days while activity was recorded on 28 days. The total period from beginning to end of hibernation was 92 days or about 3 months. Following is a record of average temperatures during periods of hibernation and activity.

STATUS	NO. OF DAYS	PERIOD	AVERAGE TEMP. (F)*	REMARKS
Hibernating	6	November 23–29	21.8	
Active	12	November 30–December 11	37.5	
Hibernating	10	December 12–21	28.5	
Active	1	December 22	22.0	Snow 6 inches deep in pen
Hibernating	12	December 23–January 3	26.4	
Active	1	January 4	24.0	Snow 3 inches deep in pen
Hibernating	2	January 5–6	40.0	
Active	1	January 7	44.0	No snow on ground
Hibernating	7	January 8–14	32.5	
Active	2	January 15–16	22.5	Snow 8 inches deep in pen
Hibernating	20	January 17–February 5	21.8	
Active	1	February 6	31.0	Snow 18 inches deep in pen
Hibernating	1	February 7	34.0	
Active	7	February 8–14	33.4	Snow 8 inches deep in pen
Hibernating	3	February 15–17	18.6	
Active	3	February 18–20	40.0	Snow 1 inch deep in pen
Hibernating	3	February 21–23	15.6	

* Temperatures taken at U. S. Weather Bureau Station, Ithaca, New York.

J. Kenneth Terres, *Soil Conservation Service, Utica, New York*

A SENILE GRAY FOX

In December, 1938, a gray fox (*Urocyon cinereoargenteus*) was killed on Wilbraham Mountain, near Springfield, Massachusetts. The animal was a male, fat, in splendid condition, and weighed 19 pounds. Attention was attracted by the fact that the fox was practically toothless. The upper jaw has a single incisor tooth. The lower jaw has a much worn canine on one side, with a single peg-like premolar; on the other side is a worn carnassial. Roots of the last lower molar are visible on one side of the mandible, and those of a first upper premolar are present in the upper jaw, showing that these

teeth have not been long lost. The skull shows characters of age, but is not importantly different in size and shape from that of ordinary adult wild gray foxes.

That this practically toothless fox was in excellent condition would indicate that it found food that did not require cutting up. It must have been impossible for this fox to eat poultry, game birds, or rabbits. Mice, carrion, garbage, and fruit play important parts in the diet of foxes, but it would appear that they must have been the sole foods available for this old animal.

The skull was saved by Mr. Wm. E. Buckner who collected the animal; it was sent to the American Museum of Natural History by Mr. Hyatt Verrill of Springfield, Massachusetts.—JOHN ERIC HILL, *The American Museum of Natural History, New York City.*

WEIGHTS OF EASTERN BOBCATS

During the course of an investigation of the food habits of Vermont bobcats, records were obtained on the weights of 74 cats (*Lynx rufus rufus*) that were trapped or shot for bounty during the winters of 1936-1938. The weights were obtained by State game wardens and in several instances by Dr. Russell P. Hunter, then director of the Vermont Fish and Game Service, who provided me with these data. The skulls of many of these cats were available for study, and these gave a fair index to the age of the animals.

The average weight of 74 bobcats was 15 pounds, 4 ounces. The heaviest, a large male with massive skull and slightly worn teeth, weighed 36 pounds. Nine cats weighed more than 25 pounds each, seven of these weighing 30 pounds or more each. Estimated weight is usually faulty. One cat whose estimated weight was placed at 30 pounds, weighed 4.5 pounds when skinned. Nine cats averaged 5 pounds. These were all taken in October and November, and were undoubtedly kits of the year. The weights do not indicate any sharply defined age group, although there is a suggestion of a group between 10 and 14 pounds, and another between 18 and 21 pounds. The available skulls tend to support this evidence.

Practically all of these bobcats were in good condition, with a substantial amount of fat.—W. J. HAMILTON, JR., *Cornell University, Ithaca, New York.*

COLOR VARIATION IN THE PIUTE GROUND SQUIRREL

Study of the Piute ground squirrel (*Citellus townsendii mollis* (Kennicott)) over a period of four years in Churchill County, Nevada, showed that these animals are colored like others of the subspecies at hand, and as described by Howell (North Amer. Fauna, no. 56, p. 63, 1938) for the gray phase, except in one area of about 16 square miles northwest of Soda Lake. There, ninety percent of the animals seen in the field appeared to be albinistic, though on close examination their eyes could be seen to be pigmented.

The pelage of squirrels in this limited area is of many varying shades of "smoke gray" (Ridgway, Color Standards and Color Nomenclature, 1912). The guard hairs on all specimens handled were black for the full length of the hair. These black hairs help to give the light-colored squirrels a smoky gray color; if their guard hairs were removed, many individuals would be white. However, of about forty light-colored squirrels examined each had a brown supraorbital patch; the tail was wood brown, lighter on the dorsal surface. Possibly the pale color of the squirrels is protective; at any rate it closely matches the color of the soil in this restricted area.

It may be added that this color appears not to be either the kind which Howell (1938, p. 64) refers to as the "buff phase" in this subspecies, or the pale mutation described by Clark and Jellison (Jour. Heredity, vol. 27, p. 259, 1937) in *Citellus "elegans"* [= *Citellus richardsonii aureus* Davis].—J. R. ALCORN, *California Museum of Vertebrate Zoology, Berkeley, California.*

RED SQUIRRELS CHASED BY ROBINS

The observations included here were made during the spring of 1939 at Ithaca, New York. A family of red squirrels, *Tamiasciurus hudsonicus loquax* Bangs, consisting of the parents and 4 young, were reared in an American elm, the branches of which overlapped with another of the same species containing a robin's brood. The purpose of the data given here is to present additional information supplementing the already available literature about red squirrels in relation to robins.

Authors who have observed robins successfully raised without predation by squirrels in red squirrel communities are: Thoms (Bird-Lore, vol. 24, p. 206, 1922), who concludes that "unless squirrels are overabundant they do no harm to the bird population, which easily recovers the small losses incurred". Klugh (Jour. Mamm., vol. 8, pp. 1–32, 1927) recorded three cases in which broods of robins were successfully reared in areas frequented by red squirrels. Seton (Life Histories of Northern Animals, vol. 1, p. 322, 1909) quotes W. Brewster's observations on a red squirrel that jumped over a robin's nest daily without harming the eggs or developing young. Seton states on the same page, however, that in June, 1906, at least three robins' nests in his garden were rifled of their new-hatched young by red squirrels. Walton (A Hermit's Wild Friends, 1903, p. 247) observed no instances of red squirrels' robbing nests of wild birds over a period of 15 years in Maine and 18 years on Cape Ann.

My information would indicate at least for the red squirrel family studied that robins are quite capable of taking care of themselves against adult as well as young squirrels. In their search for food the young and old squirrels often jumped from their tree into the one containing the nest of young robins. The adult robins paid no attention to the squirrels and allowed them to feed as long as they did not approach within 10 or 15 feet of the nest. However, when the squirrels ventured within this distance the birds gave chase to their "red enemies."

The adult robins made their initial attack on the red invader by darting toward the squirrel and crying as if in alarm. This was the signal for the squirrels to run or to suffer the consequences; they always ran. The red squirrels in their attempt to evade the robins followed a resourceful "plan" of escape, circling around the tree, thus keeping the trunk between themselves and the birds. This spiral course around the tree was often continued to the ground, the robins following in hot pursuit, but handicapped by branches and by the larger circumference that they had to traverse in their attempt to reach the squirrels. When the squirrels gained the ground they would run to a neighboring tree and begin its ascent, the robins ceasing their chase as soon as this took place. If the squirrels were able to reach a place in their descent of the robins' tree where they could leap to a haven of retreat without exposing themselves to the pursuing birds, they would always take this course.

The young squirrels were especially venturous and made repeated trips to the robins' tree, although pursued in every instance. Once there, they showed no fear of the robins; time after time they approached the nest only to be chased away. These youngsters were apparently not so agile or resourceful as their parents, and often instead of circling a tree when followed by a robin would run straight down its trunk, thus offering a surer target for the bird if it cared to attack. The young squirrels did not seek to jump to a nearby tree, but usually ran to the ground and then climbed an adjoining elm. Several chases were seen in which the young squirrel on reaching the ground seemed confused, and instead of going to another tree ran into the shelter of clumps of shrubs in front of a nearby house. One, in his mad dash to get away from a robin, even ran under the lattice-work of the front porch of this house. The young squirrels would often give voice in a frightened cry when pursued, something seldom done by the parents.

It is obvious that some robins can ward off possible would-be attackers of their young. In no instances were the adult birds observed striking the squirrels. Their sole purpose seemed to be to scare their red neighbors from the vicinity of the nests, a feat which they always accomplished.—WILLIAM MARCUS INGRAM, *Cornell University, Ithaca, New York.*

FEEDING HABITS OF THE RED SQUIRREL

In connection with some field work on Mt. Timpanogos, Utah County, Utah on August 8, 1938, I had occasion to observe first hand some of the feeding activities of the Wind River Mountain red squirrel (*Tamiasciurus hudsonicus ventorum*).

Stopping to rest under a large Douglas fir (*Pseudotsuga mucronata*) after a brief thunder shower, I noted a squirrel on one of the branches about ten feet from the ground, busily feeding. Within a few seconds the animal ran out to the end of a branch and with one deft movement clipped off a fully grown green cone which it carried in its mouth to a solid limb where it proceeded to feed upon the contents.

The cone was held in the hands, and the scales, beginning at the basal end, were stripped off with the teeth and flipped away with the right fore foot after the seed had been eaten. The process of stripping a cone occupied almost exactly two minutes. During the course of about 25 minutes, the seeds from nine cones were devoured. Doubtlessly several cones were stripped before I began my observations.

Following this feeding period the squirrel moved away into another tree where I was unable to watch its activities further. I took occasion at this time to obtain some of the cones and count the seeds. Forty-five was the average number of seeds found in each of several cones examined. This would make about 400 seeds actually consumed. Assuming that the animal ate the contents of 12 cones in this single meal, the total number of seeds would amount to about 540.—C. LYNN HAYWARD, *Brigham Young University, Provo, Utah.*

WEIGHTS OF POCKET GOPHERS

Included in the records of 104 pocket gophers (*Thomomys fuscus fuscus*) collected by W. W. Smith for the Bureau of Biological Survey are the weights of the animals in the flesh. The specimens were taken in Livingston, Montana, during every month of the year.

Adult males (49 individuals) averaged 101.77 grams, and varied from 78.35 to 145.95 grams. The average weight of 55 adult females was decidedly less—88.81 grams, with extremes of 67.52 and 119.95 grams. The average difference in weight between the sexes varies considerably from month to month; in March and October it is more than 25 grams, and in February and December it is less than 2 grams.

Weight records are comparatively scarce, and it is hoped that presentation of these data will stimulate interest in recording such information whenever obtainable. It is easy to include the weight on the record of capture and thus preserve data that would otherwise be unobtainable.—CLARENCE F. SMITH, *Biological Survey, U. S. Department of Interior, Washington, D. C.*

NOTE ON BREEDING OF BEAVERS

Since my article, "Breeding Habits of Beaver", was published in the November, 1939 issue of the Journal, I have received an interesting letter from Mr. Frank Kahan, who is experimenting with beavers in Arlington, Washington. Mr. Kahan does not agree with the observations made by the four individuals quoted by me, but thinks that these people were observing merely a "wrestling play" type of activity, and that he has observed the real mating procedure. In view of the extremely limited and incomplete list of such observations, it occurs to me that Mr. Kahan's observations would be of interest. They are as follows:

"Breeding Habits of Beaver" interested me especially. Mr. Klever's account of two beavers that were nearly upright in the water with their fore limbs around each other, leads me to think that what he really saw was a wrestling match instead of the act of breeding. I have seen beavers wrestling many times. Their cheeks are against each other, their fore limbs around each other, and they struggle vigorously, each trying to force the other backwards and cause him to break his hold. It is true that during these bouts the animals are not "nearly upright in the water" but often as the defeated one loses his hold and is forced over backward for a brief period they are in nearly an upright position. At times when their feet touch bottom in shallow water they are actually upright for a short time.

Perhaps you would be interested in the following notes copied from my records just as they were written down at the time. These observations were made in a large enclosure about 200 by 400 feet thru which flows a creek that the beavers dammed, making a large pond back of a dam 150 feet long.

May 17, 1933. Brownie and his mate breeding. Time 5.30 p.m. While the female was swimming the male clasped her above the hips with his fore limbs and turned on his side, hanging on while the female swam slowly for a moment. Then they churned the water and dived with a splash. Upon coming to the surface they swam to shore, climbed out and sat side by side combing themselves. A few minutes later the female entered the water, the male followed and the same performance was repeated. The female had been thin and poor until recently as a result of injuries received some time before. It may be because of these injuries that she did not breed at the normal time.

August 28, 1939. The female's teats showed very prominently just about the time that she was due to have young if the gestation period is 90 days, but after Aug. 20th I noticed they gradually decreased in size, so it is apparent that something happened to the young. Perhaps the young were too crowded with eight in the enclosure, and the young were trampled or smothered.—G. W. Bradt, *Game Division, Michigan Department of Conservation, Lansing, Michigan.*

GRASSHOPPER MOUSE USES TOBACCO AS AN INSECTICIDE

"Ony", a pet grasshopper mouse (*Onychomys leucogaster*) that lives in a cage on my desk at home, is given liberty of several hours each evening. Frequently I have noticed, after he had been running about the desk, that very small cigar stubs which I had left in the ash tray had been carried to his favorite location on the desk and completely demolished.

My first thought was that he was merely amusing himself; but this explanation did not satisfy me. Recently I offered him one of my small cigar stubs after he had been without such material for a short time. He immediately took it, carried it to his favorite corner, held it in his hands and took a small bite from the end I had held in my mouth. He chewed the morsel briefly and then bent around, separated his fur with his hands and placed the chewed tobacco on his skin at the base of the fur. He took another bite, chewed it briefly and placed it similarly. He did the same thing at various parts of his back, thighs, and under parts. This procedure has since been witnessed by both my wife and myself and by visitors on several occasions.

As he has been kept well supplied with insect powder I am confident he has no ectoparasites; but no doubt he does not distinguish between the common itchiness of the skin that occurs on all furry creatures and the special irritation caused by parasites.

When I first noticed that he used the tobacco in this manner, I wondered at the instinct or reasoning that prompted him to do so. Mr. Vernon Bailey, who gave "Ony" to me, reminds me that two species of wild tobacco normally occur in the general range of this grasshopper mouse. It is therefore possible that the use of tobacco as an insecticide is a normal but hitherto unnoticed habit of the species.—Ernest P. Walker, *National Zoological Park, Washington, D. C.*

NOTE ON THE DEATH OF A YOUNG DEER MOUSE

An adult male deer mouse, *Peromyscus maniculatus gracilis*, was caught in a spring mouse trap in the basement of a home in Hanover, New Hampshire, October 10, 1939. Attached to the inner surface of its ear by a blood clot, were the dried remains of a young deer mouse about half the length of the adult. The skin of the young one seemed to be intact, although dried and practically devoid of hair. The blood had collected in the region of the forelegs over the heart.

The adult may have come into contact with the young one just as the blood was coagulating, and the sticky blood may have furnished a connection strong enough to hold the two animals together. Since the young one was in a very dry condition when found, the two bodies must have been attached for a considerable time.—RICHARD LEE WEAVER, *Darthmouth College, Hanover, N. H.*

A RECORD OF THE CARIBOU IN MICHIGAN

There is a record of the caribou (*Rangifer caribou caribou*) in Michigan that seems to have escaped mention in any faunal publication. It is to be found in John H. Pitezel's, Lights and Shades Of Missionary Life (Cincinnati, 1860, p. 195). On March 2, 1849, Pitezel visited some Indians on Carp River, Chippewa County; he wrote: "One of the viands was a great treat—it was *Cariboo* meat, tender and sweet as any venison."—A. W. SCHORGER, *168 N. Prospect Ave., Madison, Wisconsin.*

AMERICAN BISON IN NORTHERN LOUISIANA

On March 22, 1700, Bienville left the Taensa villages on Lake St. Joseph in the northeastern part of the present state of Louisiana intending to visit the Natchitoches villages close to the present town of Natchitoches on Red River. He effected his object under great difficulties, experiencing constant rains and being obliged to wade through swamps for miles.

March 25 when about 15 leagues west of Lake St. Joseph in the direction of Columbia on the Ouachita River, where the party appears to have crossed, they killed a bison. They marched that day 6 leagues, wading all the way, until they came to the edge of a prairie where they killed the animal. This must have been in the neighborhood of Winnsboro. They crossed the Ouachita on March 30 and after traveling in a general southwesterly direction for about 12 leagues, according to their calculations, their hunters killed a bull bison, a cow, and a calf. This must have happened somewhere in Winn Parish. See Pierre Margry, "Découvertes et Établissements des Francais dans l'ouest et dans le sud de l'Amérique septentrionale (1614–1754)" Paris, 1880, volume 4, pp. 433–436.—JOHN R. SWANTON, *Bureau of American Ethnology, Smithsonian Institution, Washington, D. C.*

MANATEES AND THE FLORIDA FREEZE

The extended period of exceptionally cold weather that struck Florida during the last week of January, 1940, did serious damage to the manatee population of the southern part of the State. From January 26 to 29, inclusive, the air temperature of Charlotte and Lee Counties hovered around 19°F.; the water temperature of Charlotte Harbor (Charlotte County) dropped from 68°F. to 46°F. On the morning of January 28, low tide in the mouth of the Peace River, which discharges into Charlotte Harbor, revealed four manatees dead on the shore-line and on sand bars. A fifth was found dead near the mouth of the Caloosahatchee River near Ft. Myers, just south of the entrance to Charlotte Harbor. In length these measured: 6 ft., 8 in.; 7 ft., 2 in.; 7 ft., 10 in.; 8 ft., 2 in.; 8 ft., 5 in. Aside from one new-born baby found dead two years ago (probably still-born), these are the only dead manatees known to have been found in the region

during the last quarter century. Since these deaths coincide exactly with the prolonged and extreme cold, it would seem that the deaths can be related only to the cold, though the fact cannot be proved. There was no evidence of either injury or disease. Since manatees are very rare in the area, this mortality, which may well include others not found or reported, is a serious threat to the survival of the species.—A. R. CAHN, *Cleveland, Florida.*

EFFECT OF BURNING AND GRAZING ON RODENT POPULATIONS

Comparison of trapping records on prairie lands and fallow rice fields in Colorado County, Texas, indicates that burning and grazing play great havoc with small rodent populations.

The coastal prairie north of Eagle Lake, Colorado County, where the studies were made, is a grassy country of sandy soil, level enough, in most places, for the cultivation of rice. A total of 248 trap nights using museum style mouse traps set during October and November, 1938, and February, 1939, 6 to 12 miles north of Eagle Lake gave the following results:

In prairie pasture lands, moderately grazed, and usually burned at least every two years, 92 trap nights showed a catch of one harvest mouse (*Reithrodontomys fulvescens aurantius*) and one baiomys (*Baiomys taylori subater*).

In a small area of prairie where burning and grazing have not occurred for several years and where vegetation has grown up much as it was in the original state, the catch in 99 trap nights was 9 harvest mice and 5 *Baiomys*. These mice were taken in rabbit and armadillo runways adjacent to wax myrtle and dewberry brush.

In fallow rice fields 57 trap nights showed a catch of 11 cotton rats (*Sigmodon hispidus texianus*). The line of traps was set across a field, but most of the rats were caught near heavily overgrown canal banks and levees.

A catch of 2 mice in 92 trap nights on prairie pasture lands regularly burned as compared with a catch of 14 mice in 99 trap nights on unburned and ungrazed prairie indicates a definite reduction of the small rodent population by burning and grazing. Burning is the greatest adverse factor in this region. Grazing, although severe in some cases, is not so widespread or so destructive as fire. Prairie firing begins in the fall and continues through the spring months. Some ranchers prefer to burn every year while others burn every other year. At these prairie fires the hawks that winter on the coastal prairie gather in large numbers. In January, 1939, 10 red-tailed and Sennett white-tailed hawks were counted at one fire. Marsh hawks, sparrow hawks, and Swainson hawks also have been observed at burns. With fire and sharp-eyed hawks working together, it is a wonder that any rodents survive.

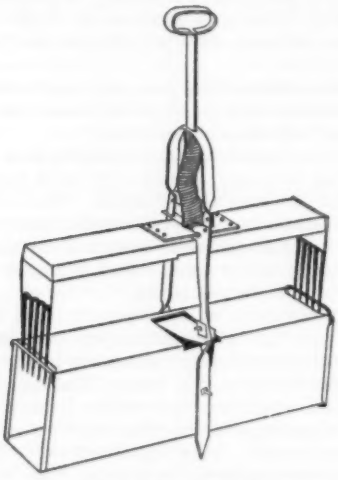
In fallow rice fields, where damp conditions generally prevail and burning is not prevalent, 11 cotton rats in 57 trap nights indicates a fairly high population. Here along canal banks and rice levees vegetation is thick and little grazed. Cotton rats have also been found inhabiting rice stacks along with the introduced rat (*Rattus* sp.).

The fact that no shrews (*Cryptotis parva*) were taken is curious. As shown in the article "A Heavy Concentration of Cryptotis" by Davis (Jour. Mamm., vol. 19, pp. 499–500) shrews constituted 41 percent of the mammalian remains found in owl pellets collected within 6 miles of the trapped areas.—ROLLIN H. BAKER, *Texas Cooperative Wildlife Research Unit, College Station, Texas.*

A LIVE MOLE TRAP

Occasional requests for information concerning methods of obtaining live moles for study prompt the submission of data on a live trap used by the Control Methods Research Laboratory of the Bureau of Biological Survey.

As will be seen, one of the commercial harpoon-type traps forms the mechanical part of the trap. Two makes of harpoon traps have been used with equal success. The riveted heads of the harpoon spikes are ground off on an emery wheel and the spikes punched out. The box shown is constructed from medium-weight galvanized iron sheeting, and measures 5 inches high, 3½ inches wide, and 15 inches long. It has wire-rolled ends. A hole is cut in the top to accommodate the trigger; this extends a short distance down the side to take care of the twist found in the upright. At each end of the top a slot opening is provided to accommodate the end gates, which consist of five or six 60-penny finish nails brazed to a heavy plate of sheet metal. Two holes are drilled through each plate for the screws that attach the plates to a strip of finish lumber measuring ¾ by 2¾ by 14 inches. About a ½-inch notch is made in one side of the wooden strip to allow for trigger clearance.



LIVE MOLE TRAP

The metal box is attached to the uprights with three bolts, two on one side, one on the other. One of the uprights must be twisted so as to allow it to lie flat with the box. This is easily done in a vise. The wooden strip is attached to the metal plate on the spring with four round-headed wood screws through the holes from which the harpoon spikes were punched.

As originally designed, the end gates were of heavy sheet iron. In many instances excessive soil friction did not allow the trap to close completely. The nail-brazed plate was therefore substituted. Care should be taken that the brazing does not burn the nails and so allow them to be sprung apart by captive moles.

In setting the trap, the handle should be lifted and a block placed under the raised wooden strip as a safety precaution. Moist soil is placed in the box and in that part under the trigger it is packed firmly. This may be done by reaching both arms into the box and tamping with the fists. The ends are filled to a medium compactness. The addition of earthworms to the soil within the box seems to be of advantage.

To place the trap, a straight section of a mole runway is located with the use of a slim

metallic rod, or probe, and enough earth is excavated so that the trap may be fitted snugly in the runway, the runway course passing through the middle of the trap box. Clearance should be allowed for the trigger assembly at the side of the trap, and finally a little loose moist soil should be placed at the end of the trap to exclude all light.—A. W. Moore, *Biological Survey, U. S. Department of Interior, Hillsboro, Oregon.*

REVIEWS

Gregory, Tappan. Eyes in the Night. Thomas Y. Crowell Co., New York. 8 vo., pp. xi + 243, illus. with halftones and drawings.

Under the apparently fanciful, but actually realistic, title of "Eyes in the Night," the author describes by word and picture his more recent experiences in flashlight photography of mammals at night in the wild, and reviews some of his earlier endeavors. Gregory takes us from the small mammal fauna, the rodents and carnivores, of his own backyard in Illinois and the Lake Superior region to coyotes in Montana, timber wolves in Louisiana, and bobcats and mountain lions in the Carmen Mountains, Mexico, as well as to deer, moose, badgers, raccoons, bears, in several regions. He not only carries us with him on his camera-hunts, but, as a naturalist, he gives us many observational tidbits about the lives of the animals he stalks. These habit notes are of first importance to the work. The last two chapters tell how to hunt with a camera and what apparatus to use.

"Eyes in the Night" should afford for one's own eyes just such usage as the title suggests, since it is a delightful book for evening reading. The print is large and clear; the paper unglazed. The 44 halftones of Gregory's wonderful photographs are reproduced on the same rough paper as the text, thus effecting a soft and artistic finish. We feel, nevertheless, that some of the photographs have been reduced too much in size for best detail, since in flashlight photographs reduction tends to intensify both lights and shadows, usually already too contrasted. For example, in the picture "Four downy cubs" on page 117 the details of the red fox pups are not so pronounced as in the less reduced halftone used on the wrapper. And again, why are not the two excellent deer pictures on the wrapper preserved permanently in the book itself? The inside covers are beautifully adorned with a composite halftone of 13 photographs (not in the text) of various mammals and two herring gulls.

Gregory has a delightful way of presenting his subject, as exemplified in remarks on the white-footed mouse: "In two or three minutes a small, ghost-like shadow scurried towards the center of the circle of light, not without hesitation before finally scampering into full view. It picked up a crumb here and there from the ground, sat up straight to eat it, whirled around several times like a mad dervish and jumped this way and that in short little hops. Apparently, it was conscious of a tempting aroma, yet not quite certain of the exact location of its cause. Finally it stood at the bait, grasped the wire with both forefeet, removed a mouthful of peanut butter and sat on its haunches to eat it. It seemed incredible that its touch could be so delicate, for the long wire need move only a sixteenth of an inch to make contact with the loop of the other wire, yet this did not happen. The little mouse finished its sample of peanut butter, then stopped to wash its face and lick its fur before returning to the feast, and here an interesting thing happened. In worrying the bait, the mouse partially loosened it and slid it down to the wire loop. Some movement on my part frightened off the diner and then when I examined the trip, I discovered that the center wire was completely insulated from the wire of the loop by this stuffing of peanut butter."—Hartley H. T. Jackson, *Biological Survey, U. S. Department of Interior, Washington, D. C.*

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[Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma S. Charters.]

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recticornis Lyd.; *Sivacapra* for *Capra sivalensis* Lyd.; Caprinae genus (cf. *Sivacapra*) *crossicornis;* gen. indet. (aff. *Capricornis*) *roylei; Damalops* for *Antilope palaeindica* Falconer; *Sivoryx, S. cautleyi; Sivatragus, S. bohlini; S. brevicornis;* Hippotraginae gen. indet. (cf. *Tragoreas*) *potwaricus; Sivacobus* for *Cobus* (?) *palaeindicus* Lyd.; *Vishnucobus* for *Cobus* (?) *potulicornis* Lyd.; *Sivadenota, S. biforis;* Reduncinae gen. indet. (cf. *Sivadenota*) *sepulta; Gangicobus, G. asinalis; Indoredunca, I. sterilis;* Reduncinae gen. indet. (cf. *Indoredunca*) *theobaldi; Hydaspicobus, H. auritus; Cambayella, C. watsoni; Kobikeryx; K. atavus; Sivoreas, S. eremita; Eotragus* substitute name for *Eocerus* Schlosser preoccupied; *Sivaportax, S. dolabella; Perimia* for *Strepsiceros* (?) *falconeri* Lyd.; *Pachyportax nagrii; Tragoportax aiyengari; T. islami; Ruticeros, R. pugio; Sivaceros vedicus; Proamphibos; P. lachrymans; P. kashmiricus; P.* (?) *hasticornis; Platybos* for *Hemibos triquetricornis* Rütimeyer.)

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OBITUARY NOTICES

ALFRED WEBSTER ANTHONY

Often we find that the study of birds goes hand in hand with that of mammals. Such a "double-track" naturalist was Alfred Webster Anthony, whose achievements in both of these fields were recognized by his designation as a Fellow of the American Ornithologists' Union and an Honorary Member of the American Society of Mammalogists. Furthermore, he was a charter member of the latter organization. Born in Cayuga County, New York, on December 25, 1865, he died in San Diego, California, on May 14, 1939, at the age of 73, after a life brimfull of travel, adventure and varied experiences.

When he was three years old, he moved with his parents to Denver, Colorado, on one of the earliest through trains. If his young eyes were already awake to such things, he doubtless saw from the window buffalo and antelope on their primeval range. He grew up with the city of Denver, spending his school vacations in the mountains with his father, a mining man. In these wild surroundings were planted the first seeds of his subsequently consuming love of nature.

After attending the Colorado School of Mines, Anthony followed his father's profession of mining engineer. Briefly summarizing his movements through the years, we find that in 1887 he went with his family to San Diego and thereafter for several years engaged in placer gold mining in Lower California, Mexico. During a visit to Oregon in 1888 he met and married Anabel Klink. In the first year of their marriage, Anthony named an exceptionally beautiful bluebird in his wife's honor, *Sialia mexicana anabelae*.

Responding to the call of the sea, he made many exploring trips from San Diego to islands off the coast of Mexico—Socorro, Tres Marias, Revillagigedos, etc. Two of these voyages were made in vessels owned by him. All of them abounded in the romance and even the tragedy of the sea, including one shipwreck.

In 1892 Anthony and Charles H. Townsend visited Guadalupe Island, Mexico, where they secured information on fur seals and elephant seals. Mining was resumed in 1903, and Anthony spent three seasons in Nome, Alaska, and several years in Oregon. Then followed ten years of ranching in eastern Oregon.

At the invitation of the San Diego Society of Natural History, he returned to San Diego in 1920 and became Director of the San Diego Natural History Museum. From this position he resigned to embark, early in 1924, on a collecting and exploring trip to Guatemala. He remained there for five years, returning to San Diego with health impaired by his long stay in the tropics. Thereafter he made a few more trips by sea and land, with friends, natural history being his dominant interest to the end. His last outing of any length was to Ensenada, Mexico, made on behalf of the persecuted and vanishing southern sea otter.

As has been true of many others who later developed prominence in science, Anthony's natural history tastes were first manifested in a boyhood collection of birds' eggs. From this he soon graduated to the preparation of scientific study skins of birds and mammals. As early as the summer of 1886, while at Camp Apache, in the extreme southwestern corner of the Territory of New Mexico, he made what Dr. C. Hart Merriam declared to be "a valuable collection of mammals," containing specimens which provided the basis for two new descriptions—a bat and a white-footed mouse. Dr. Merriam named the latter in Anthony's honor—*Hesperomys* [= *Peromyscus*] *anthonyi*. Four other mammals bear Anthony's name, including the beautiful gray tree squirrel (*Sciurus griseus anthonyi*) of southern California and the rare mole (*Scapanus anthonyi*) endemic to the Sierra San Pedro Martir, Lower California. In describing the wood rat (*Neotoma anthonyi*) of Todos Santos Island, Lower California, Dr. J. A. Allen wrote in 1898 that the specimens were collected by A. W. Anthony, "in whose honor the species

is named, in recognition of his important zoological work in Lower California and its outlying islands."

A number of birds also carry Anthony's name in either their scientific or vernacular designation. His breadth of interest is further reflected in the name of the lovely Lower California succulent, *Dudleya anthonyi*, and in that of one of the best known crabs of the California and Lower California coast, *Cancer anthonyi*.

Anthony was not himself a prolific writer, being of a modest disposition and preferring that others should do the systematic work on the collections he secured. His specimens are today in possession of a number of different museums and private zoologists. The outstanding units are 10,046 birds acquired by the Carnegie Museum in 1904, the Guatemalan collection of mammals and birds acquired by the American Museum of Natural History, and the mammals and birds added to the collections of the San Diego Society of Natural History during the years Anthony was officially associated with it. He also donated to the San Diego Society of Natural History an important collection of minerals gathered by his father and himself.

Of a kindly nature and possessed of a keen sense of humor, Anthony always looked on the brightest side of any situation and never held a grudge against anyone. He was beloved of young naturalists, more than one of whom accredits his start and success in science to him. He is survived by his wife and his two sons. The elder, H. E. Anthony, is curator of the Department of Mammals, American Museum of Natural History. The younger son, Charles A. Anthony, resides in San Diego.—CLINTON G. ABBOTT.

WILFRED AUGUST WELTER

Wilfred August Welter, a member of the American Society of Mammalogists, was born in Creighton, Nebraska, March 29, 1906. In 1911 he was taken by his parents to a farm north of Verndale, Minnesota, where he attended grade school and the Verndale High School, from which he graduated in 1922. From High School he entered the Teachers College at St. Cloud, graduating in 1924. He obtained the Bachelor's degree from the University of Minnesota in 1926 and the Master's degree from the Iowa State College in 1927. He taught one year in the Teachers College at St. Cloud and one at the Teachers College in DeKalb, Illinois, before he entered Cornell University, from which he received the Ph.D. degree in 1932. At the time of his death he was Professor of Biology and head of the Science Department at Teachers College, Morehead, Kentucky.

His greatest hobbies were connected with his field: Conservation of wildlife, fishing, collecting, making colored movies of birds, animals and flowers, studying nature at close range, out-of-door cooking, field trips, boating, canoeing, travel by motor car, and building a museum of wildlife for the college.

He collected specimens and built up a museum of mammals, reptiles, and birds. He made a survey of the fish in Kentucky streams and added a large collection of specimens to the museum. He worked with the government in bat banding. He found and classified rare salamanders. He made colored movies of the flowers, birds, and other animals of this region and was much sought as a lecturer at educational and conservation meetings.

He published (with Dwight E. Sollberger) in the Journal of Mammalogy (November, 1939) a paper entitled "Notes on the mammals of Rowan and adjacent counties in eastern Kentucky."

At the age of 33 years he met his death in an automobile collision December 20, 1939, while on his way to Minnesota for the holidays.—A. H. HOWELL.

COMMENT AND NEWS

ANNOUNCEMENT OF ANNUAL MEETING

The twenty-second annual meeting of the American Society of Mammalogists will be held at The Colorado Museum of Natural History, Phipps Auditorium, Denver, from Tuesday, June 25, through Friday, June 28, 1940. Headquarters: The Cosmopolitan Hotel.

Titles of papers for presentation at the meeting, together with abstracts suitable for newspaper copy, should be in the hands of the Corresponding Secretary, William B. Davis, Department of Fish and Game, Agricultural and Mechanical College of Texas, College Station, Texas, not later than June 1. Those submitting titles are urged to supply the following information: (1) Time required, (2) projection apparatus needed, if any, (3) the days of the meeting when you will be present.

A special session devoted to papers dealing with the applied or practical aspects of mammalogy will be a special feature of this meeting. Persons who have material for such papers are urged to participate.

Further details and information may be secured from the Corresponding Secretary or from the Local Committee on Arrangements, A. M. Bailey, *Chairman*, The Colorado Museum of Natural History, Denver, Colorado.

Following the annual meeting at Denver, visitors who would like to spend a short time in the mountains may obtain board and lodging at Science Lodge, at an altitude of 9500 feet in western Boulder County, just east of the Continental Divide. Rates will be $2.00 per day, including both board and cabin.

Faculty members at Science Lodge will attempt to meet any demand for guide services for trips, either afoot or by car, to numerous points of interest and beauty along the Continental Divide in western Boulder County.

The excursion to Rocky Mountain National Park on Friday, June 28, will pass through Boulder, permitting a glimpse of the University of Colorado, thence up picturesque Boulder Canyon to the University's summer mountain laboratory, Science Lodge, where a late breakfast will be served to members of the party at about 10:00 A.M.

Visitors are invited to examine the University of Colorado at Boulder and to visit the University of Colorado Museum at their convenience.

"CONTROL" OF FLORIDA DEER

For some years the number of beef cattle in Florida has been increasing. This trend has evidently reflected the effort to utilize the tracts of prairie type of country and other areas in the state not suited to more intensive forms of agriculture. Much of this endeavor, however, falls in a submarginal classification, and as in other such activities, the individuals concerned, unable to prosper by their own efforts, eventually send forth cries of distress and demands for subsidies of one sort or another.

By all accounts the beef cattle of Florida are far below a desirable standard, and efforts to improve them, by the importation of blooded stock, are allegedly unsuccessful. Cattle do not prosper in a humid subtropical environment (in contrast to a southern arid

habitat, as in Texas). One reason appears to be that the forage crops that can be grown in such districts are not well suited to cattle, in spite of constant efforts by the agricultural experiment stations. As in most hot countries the world over, the Florida cattle are also infested with fever ticks.

Accordingly, almost every other state in the Union appears to offer greater economic inducements for nursing the cattle industry. Yet the Florida cattlemen are most vociferous in claiming a truly ridiculous value for their industry within the state, and in demanding action on their tick problem. Their contention is that deer spread ticks; ergo, deer must be exterminated. The local authorities have so willingly acceded to this plea that during the fall of 1939, 2200 deer (of which but 900 carried ticks) were killed in the western part of Collier County alone. The number killed during the winter has not been reported. The Florida legislature has provided for a 5-year period for exterminating the deer in this county and for a 2-year period of extermination in Hendry County. But in the latter area is situated the Hendry County Seminole Indian Reservation. These Indians are largely dependent upon the deer for food; their hunting rights have been guaranteed by treaty, and the Commissioner of Indian Affairs, John Collier, has said that there shall be no slaughter of deer on the reservation. Secretary Ickes has approved this stand.

As a result, a bitter campaign is being waged by the Florida cattlemen to overcome this resistance. They have marshalled their arguments and employed exaggeration with a somewhat lavish hand. Armed with a report by Dr. Shillinger of the Biological Survey, who has investigated the situation and is in favor of the program, they are bombarding congressmen and others in authority. But still there appears to have been no proof that the ticks found upon the deer are actually fever ticks (*Boophilus annulatus*) and not dog ticks, or that the ticks from the deer are carriers of tick fever. As usual, however, the pressure for extermination is so much stronger and louder than that in favor of moderation that it is questionable whether the former will not ultimately prevail.

The logical course is clear. The same problem with the same tick was successfully met in Texas without exterminating the deer, by the systematic dipping of stock and the breeding of a fever-free strain of cattle with improved beef qualities by the use of Brahma bulls. This course would be of permanent benefit and would probably cost less than exterminating the deer. Very possibly complete extermination could not be accomplished, but irreparable damage would certainly be done to the local fauna in the effort.

In certain respects Florida is more favored in her wild life equipment than any other state, and she should consider this of priceless value as a recreational attraction. Instead, she has exhibited a singular disregard of this blessing and has appeared almost to welcome irrational schemes for the exploitation and destruction of some of her unique natural resources.—A. B. H.

The hunting fraternity's attitude toward wild life is full of surprises and ingenious ideas. We imagine the record for an entirely new method of approach is established by the action, recently discussed in the Baltimore Sun (March 8 and subsequently), of members of a well-known Maryland rod and gun club. These progressive individuals, failing in their attempts to trap the weasels and foxes on their property, have adopted the scheme of poisoning the feathers of domesticated pigeons, clipping their wings, and turning them loose, so that they may fall a ready prey to carnivores. The effectiveness of the method is not reported, but its employment should be sufficient to bring a blush to the cheek of the men concerned.

A. S. Loukashkin, formerly of the Harbin Museum, Manchuria Research Institute, is now engaged in collecting mammals and birds in northern Manchuria for private collections or museums; he writes us that he expects to come to the United States in October, 1940.

MEMBERSHIP

Anyone interested in any phase of mammalogy is eligible for membership in the American Society of Mammalogists, and if elected will receive the Society's official publication, the Journal of Mammalogy, quarterly. Name and address, with remittance of $3.00 for annual dues, may be sent to the Corresponding Secretary, or to any officer of the Society. Membership is dated from the nearest January, although formal election will not take place until the annual meeting of the Society following the receipt of application.

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Separates of lists of Recent Literature appearing in each number of the Journal are available to those who desire them at a cost of 18 cents a number or 70 cents for the entire volume of 4 numbers.

WILLIAM B. DAVIS, *Corresponding Secretary*
Department of Wild Game, Agricultural and Mechanical College of Texas, College Station, Texas

ANNOUNCEMENT

A. S. Loukashkin, former head of the Harbin Museum, Manchuria Research Institute, and assistant in the Horse Disease Institute, Hsin-king, Manchuria, will arrive in the United States in October, 1940. He will accept orders from museums or private individuals for mammals, birds, and sets of eggs which he will collect in large series during the spring and summer season in northern Manchuria.

Specimens ordered can be sent to the clients immediately after collecting or brought to the United States by the collector himself. Specimens are prepared by the modern methods employed in the United States museums.

No payments in advance are necessary, all accounts being settled on safe delivery of the specimens. Price lists and information will be sent immediately on request. Address: 16 Bolshoi Prospect, Harbin, Manchoukuo.